EVALUATING CONSERVATION TECHNOLOGY FOR UPLAND FARMERS IN THE PHILIPPINES[1]

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INTRODUCTION

Research to develop improved technologies for sustainable upland farming systems in the Philippines has failed to replicate the dramatic technological breakthroughs achieved for irrigated rice production in the lowlands. This is due to the comparative neglect of upland research in the past and (relatedly) the highly varied and more demanding nature of the upland environment. Sajise and Ganapin (1991) contrast technology generation in lowland and upland environments. The lowlands are relatively homogeneous whereas the uplands are highly heterogeneous. There is considerable baseline information for the lowlands but very little for the uplands. Obtaining information for the design of appropriate technologies can rely on standard survey methods in the lowlands, as well as consultation with extension agents and research stations, whereas in the uplands it is necessary to use innovative appraisal techniques. Technology generation for the lowlands is heavily based on research station knowledge but in the uplands is more dependent on indigenous knowledge. Finally, lowland technology is more readily "packaged" for broadscale adoption while technology for the uplands has to be of the "menu" type, allowing for adaptation to local conditions.

Nevertheless, there has been considerbale effort to develop and promote conservation farming technologies, largely in a "packaged" form (Capistrano and Fujisaka 1984, Garrity 1991, Garrity et al. 1992). In the mid-1970s it was reported that a system of alley cropping, in which a food crop was planted between contour hedgerows of the leguminous tree ipil-ipil (*Leucaena leucocephala*), showed promise. Subsequent research reported improved food crop yields and dramatically reduced soil erosion and run-off with such a system. By the early 1980s hedgerow intercropping was widely advocated. Its promotion among farmers was aided by the work of the Mindanao Baptist Rural Life Centre (MBRLC) in Southern Mindanao (Region XI) which had developed a package based on *Leucaena* hedgerows termed Sloping Agricultural Land Technology (SALT) (PCARRD 1986). By the mid-1980s the Department of Agriculture and the Department of Environment and Natural Resources were promoting SALT throughout the country. Other organisations, government and non-government, were also actively involved in developing SALT and extending the technology to farmers in various regions (e.g., Kent 1985; Fujisaka 1989a, 1989b; Craswell and Pushparajah 1991; Granert 1991; Pava et al. n.d.).

However, important problems have emerged with the new technology, limiting its acceptability to farmers in many locations (Capistrano and Fujisaka 1984; Garrity 1991; Garrity et al. 1992). Garrity et al. (1992) conclude: "The experience of the past 15 years [in the Philippines] with alley cropping and contour hedgerows suggests that appropriate solutions must be uniquely tailored to diverse soil and environmental conditions, farm sizes and labour

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availabilities, markets, and farmer objectives" (1992:23). They add that "there has yet been little attempt to clarify the appropriate hedgerow technologies for the range of specific local physical and institutional settings" (1992:23). More generally, Craswell and Pushparajah (1991) argue that "the use of agroforestry systems [such as contour hedgerows] to stabilise hillsides in southeast Asia would seem to have wide application.... However, more on-farm research is needed to evaluate these technologies and identify key factors determining the rates of farmer adoption, which have been disappointingly slow in many areas" (Craswell and Pushparajah 1991:96).

The need to evaluate these conservation farming technologies in more detail gave rise to a collaborative research project commissioned by the Australian Centre for International Agricultural Research (ACIAR).[2] The project has adopted a two-pronged approach: (1) modelling the biophysical and economic impacts of alley cropping with contour hedgerows; (2) surveying farmers in various locations where these and other conservation technologies have been promoted. After briefly discussing the general question of technology development and evaluation, this paper presents findings from one of the surveys, that of the village of Pananag in Southern Mindanao, where the MBRLC itself had implemented an extension project to promote the adoption of SALT.

TECHNOLOGY DEVELOPMENT AND EVALUATION

In general, agricultural technology development can be viewed as proceeding through "notional", "preliminary" and "developed" stages (Anderson and Hardaker 1979). Scherr and Muller (1990) have a similar developmental sequence in view when they distinguish "experimental", "prototype" and "off-the-shelf" technologies for agroforestry. Thus the notion of contour hedgerows for alley cropping on sloping land provides the basis for detailed experimental work on a contour hedgerow system which indicates that such a system is technically feasible and can increase crop yields, reduce soil erosion and provide additional products and services. However, this preliminary or prototype technology is not fully developed, or ready for "off-the-shelf" implementation, until it is adapted to the specific goals and circumstances of individual farmers, for example, through modifying the cropping pattern, the choice of hedgerow species, the management of the hedgerow, and so on.

Notional technology can be evaluated by using intuition or formal analysis (e.g., modelling). Preliminary technology requires substantive evaluation techniques, including laboratory experiments and on-station field experiments. Developed technology requires evaluation under real-world conditions, for example, on-farm experiments and pilot projects. In general, evaluation becomes more costly as the technology becomes more developed. This is because the evaluation techniques in themselves become more costly (e.g., on-farm experiments are more costly than on-station experiments). Also, the more developed the technology the more location-specific it is. This raises the cost of evaluation by requiring that evaluation be done in many locations. If the direct cost of evaluation is kept down by restricting the number of locations, the opportunity cost of neglecting other locations will be high. Moreover, given that farmers' circumstances are continually changing, the adaptation of technology is an on-going process.

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[2] The project is formally designated ACIAR PN9211 "Socio-Economic Evaluation of Soil Conservation Technologies for Upland Farming Systems in the Philippines". The organisations involved are the University of Queensland and the Southeast Asian Regional Centre for Graduate Study and Research in Agriculture (SEARCA).

The implication is that too much fine-tuning of technologies by researchers before assessing their acceptability to farmers is inappropriate. Technologies should be evaluated from a farming systems perspective when they are at the notional or preliminary stage and thus still potentially applicable across a wide range of farmer circumstances. Promising "prototypes" can then be selected for development in various locations. Scherr and Muller (1990) observe that "most agroforestry technologies that are currently available are "prototypes", that is, specific "best bets" whose designs are based on available information within and/or outside the project area, which are generally not validated locally. These may be introduced on a pilot basis with intensive monitoring and farmer input for validation and adaptation to local conditions" (Scherr and Muller 1990:263).

Given the preliminary nature of much of the technology designed for upland farmers, development projects in upland areas have selected "best bet" or "prototype" technologies for implementation. Scherr and Muller (1990, 1991) reviewed 108 agroforestry projects worldwide. They remark that "in most cases, agroforestry technologies promoted in development projects are disseminated to farmers without formal verification of their effectiveness in meeting project or farmer objectives. This is due to the lack of applied and adaptive research results, and the time pressures of the typical project life cycle" (Scherr and Muller 1991:236). As a consequence, many projects have incorporated technology assessment procedures in order to improve their extension recommendations during the course of the project, though "technology evaluation by projects is mostly limited to biological aspects and to variables that are conventionally assessed in agriculture and forestry research [e.g., tree survival and growth]" (Scherr and Muller 1990:267).

There is thus considerable scope for conducting technology-evaluation research on both on-going and completed development projects, to examine the fate of new technologies under farmers' conditions. Scherr and Muller (1990, 1991) provide methodological guidelines for such research (see also Raintree (1987)). Scherr and Muller suggest that "projects and researchers work much more closely together in agroforestry research and development. Projects can play valuable roles in generating hypotheses to be tested by researchers and also in identifying needed methods which can be developed through research" (1990:279). Raintree (1987) concludes a lengthy review of ICRAF's diagnosis and design procedures by observing: "Ultimately, ... the theory and practice of agroforestry diagnosis and design must come to rest on the empirical foundation of a large body of case study results. At present, although there is a growing knowledge base on agroforestry techniques from research projects and from the study of existing agroforestry systems, there is still a paucity of published case study material" (Raintree 1987:242).

The remainder of this paper presents a case study which assesses the way in which farmers in Southern Mindanao responded to the extension of Sloping Agricultural Land Technology (SALT), the prototypical form of conservation technology for the uplands.

A CASE STUDY

The Promotion of SALT by the MBRLC

The Mindanao Baptist Rural Life Centre (MBRLC) at Bansalan in Southern Mindanao aims to facilitate agricultural development of upland farming communities (particularly indigenous communities) characterised by poverty, an inability to meet household subsistence requirements, and a degraded land resource. Agricultural development is based on the extension of Sloping Agricultural Land Technology (SALT). The MBRLC has a SALT demonstration farm and experimental plots on which components of these technologies are tested. The farm is designed for a family with 1.5 labour units and comprises a one hectare, contoured alley cropping system. Contoured double hedgerows of nitrogen fixing shrubs or trees are laid out at three to five metre intervals. Once established, these hedgerows are trimmed up to twelve times a year at waist height, the trimmings being used as a green manure in the alleys. Every third alley is planted to perennial crops such as coffee, cacao, citrus and other fruit trees. Other alleys are planted alternately to cereals (maize, upland rice, sorghum), other crops (sweet potato, melon, pineapple, castor bean) and legumes (soybean, mungbean, peanut); crops are grown in rotation to minimise pest problems and maintain soil fertility. Zero or minimum tillage is used on the alleys. Over time, terraces develop, with hedgerows acting as the anchor for each terrace. When using a 3.8 metre spacing, fully established hedgerows, perennial crops and annuals respectively occupy 27%, 30% and 43% of the total land area. Where possible, tree species for timber and firewood, (e.g., mahogany, teak, casuarinas, sesbania) are planted on the boundary of the farm, while a forested area is developed at the top of the farm. In addition, variants of SALT have been developed, for example, one which allocates a portion of the farm for forage production to support intensive goat rearing using a cut-and-carry system.

Training in SALT is conducted at the Centre, using a standard, ten-step methodology. Farmers and extension workers from all over the Philippines (and elsewhere in Southeast Asia) have been trained at the Centre. Initially, the MBRLC did little in the way of systematic extension of SALT to farmers in surrounding districts, expecting that the demonstration farm and associated training program would be sufficient. However, since 1988/89 the Centre has been using a longer term, community-based extension approach for promoting SALT in selected villages. This "impact area" approach comprises four stages: (a) entry to the community, promoting awareness of land degradation and methods by which the problem may be addressed, and securing a core group of farmer cooperators; (b) securing a large number of cooperators and encouraging expansion of SALT projects with the aim of achieving a critical mass, i.e., a sufficient level of adoption to enable further adoption to occur without outside support; (c) introduction of SALT variants, i.e., with livestock and fruit tree components; (d) a period during which the extensionist prepares the community for no further contact.

Farmers are encouraged to try out SALT on a 0.1-0.25 ha plot. The ten-step methodology is imparted by means of farm demonstrations and house and farm visits by the extensionist, who often provides on-farm help. No community-based exchange labour systems are introduced. Cooperating farmers are provided with a starter package of P400 of materials, including leguminous hedgerow seed sufficent for establishing 0.25 ha of SALT, and an option of obtaining more seed or planting material for perennial crops with the remainder.

The limited number of farm demonstrations, with follow-up to the household and farm, suggests that SALT is not overly demanding of farmers' knowledge and skills. However, it appears that persuading farmers to adopt SALT involves a long-term commitment to a community and thus limits widespread and rapid dissemination of the technology.

The Case Study Village: Pananag

A reconnaissance of the MBRLC's extension sites in Bansalan Municipality was conducted in November, 1993, and a household survey of the village of Pananag was conducted over a four-week period in February 1994. It was decided to conduct a complete enumeration of Pananag to allow a thorough investigation of the adoption, non-adoption, and abandonment of SALT in what was the oldest extension site. The population lists obtained indicated that there were 81 households distributed over four sub-villages (*purok*). Eight of these households were seeking off-farm employment at the time of the survey and hence could not be interviewed. Of the 73 households interviewed in Pananag, 49 (67%) were classified as adopters (including 12 who were not currently cropping between hedgerows) while 24 (33%) were classified as non-adopters.

Pananag is located on the slopes of Mt. Apo (within the boundaries of the Mt. Apo National Park) in Southern Mindanao. The environment is typical of the adverse circumstances facing upland farmers in the region. Most of the annual rainfall of 1,200 mm falls between May and October, the period between November and April being relatively dry. Topography ranges from rolling to hilly on the ridges to steep to very steep in the gullies of the Mati and Miral Rivers. The dominant soil type is moderately acidic, with low to moderate fertility and a topsoil depth of 15-100 cm. In the absence of soil conservation measures, farmers reported that severe erosion was occurring on fields cultivated with annual crops.

Despite physical proximity to Bansalan town, the community is relatively isolated due to the poor road condition. There is a marked absence of infrastructure, services and extension. Indigenous Bagobos and immigrant Visayans comprise the population. Their households are interspersed and generally located close to the road. Household size averages 6 but may be as high as 12. Households own one or two parcels of land with an average total area of 2.5 ha. The traditional farming system includes production of maize, annual crops/vegetables, livestock, cash perennials, and fruit and forest trees.

The Bagobos traditionally practised a shifting cultivation system for the production of maize in which parcels were cultivated for several croppings and subsequently allowed to regenerate under fallow vegetation. While population growth (both natural and through in-migration) has caused land use to be intensified, short-fallow cultivation, whether by rotation between sub-plots on a large parcel of land or between spatially distinct plots, continues to be the basis of maize cultivation.

Maize is cultivated twice a year, with planting in March and August. Visayan farmers are better endowed with resources than Bagobos, hence they generally have *carabao* (buffalo) which are used in land preparation and weeding, and are more likely to cultivate hybrid varieties and apply inoganic fertilisers. The Bagobos commonly clear land by burning the dry vegetation and plant maize with dibble sticks. Use of hybrid varieties and fertiliser is less common. While sale of maize does occur after the first cropping, most households report that they are unable to meet their subsistence maize requirements.

Proximity to Bansalan has stimulated the commercial production of annual field crops and vegetables, e.g., peanut, chilli, egg plant, tomato, beans, squash. Traders have initiated contract production of such crops by providing the capital inputs for their production on the condition that they receive the entire harvest. The Bagobos also produce tuber crops which are primarily used to overcome the period of food deficit between December and March, although some produce is also sold.

Most households have pigs, goats and chickens which are important sources of cash income. Smaller numbers also have *carabao* and horses. Cash perennials, primarily coffee and coconut, are produced by some households. Fruit and forest trees are generally used for home consumption only. Finally, off-farm employment (mainly as farm labourers on neighbouring farms) is important to many households as a source of income.

The Farmers' Response to SALT

Adopters were defined as farmers who had established the SALT system for the production of maize; this included farmers currently using the system for maize production as well as those who were fallowing their SALT plots. Of the 73 households surveyed, 49 were identified as adopters, 12 of whom were not cultivating their plots. SALT adoption appears to have been primarily motivated by concerns for resource depletion (i.e., erosion and loss of fertility) but also by a need to increase the supply of forage for livestock, and the opportunity to obtain higher incomes through the sale of hedgerow seed.

Adoption did not appear to be influenced by ethnic group, religious affiliation, household size, labour availability, or the age and education of the household head (Table 1). However, land tenure was clearly a factor (Table 2); 84% of adopters were owner-cultivators or, more strictly, "claimant-cultivators" (Batangantang and Collado, 1995), 4% were tenant-cultivators, and 12% were mixed tenure farmers. The corresponding figures for non-adopters were 62%, 38% and 0%. Hence it appears that tenancy was a strong disincentive to adoption. While two adopters were tenant-farmers, it is noteworthy that the six adopters who were mixed-tenure farmers did not implement SALT on their rented parcels but on their own land. A number of tenants stated that landlords actually forbade land development with SALT. Farm size also appeared to influence the decision to adopt (Table 3). Adopters operated and owned a significantly larger total land area than non-adopters. This enabled adopters to compensate for the area lost to hedgerows by expansion of the total area cultivated with maize. Results indicated that ownership of *carabao* was also an important determinant of adoption. *Carabao* facilitated preparation of land for planting of contour hedgerows. Interestingly, though, none of the non-adopters specified lack of *carabao* as a constraint to adoption.

There were several differences between SALT as recommended by the MBRLC and the modified SALT system adopted by farmers in Pananag (Fig. 1). The technical aspects of hedgerow adoption (the use of double hedgerows, within-row spacing, alley width) generally appeared to be within MBRLC guidelines but SALT plots were generally small and only occupied a fraction of the area devoted to maize production. With regard to the cultural specifications of SALT, farmers only trimmed their hedgerows once or twice a year at the beginning of the maize cropping season. This appears to have been motivated by the opportunity to obtain cash from the sale of legume seed (though a lower growth rate of hedgerows compared to the MBRLC site, and a desire to reduce labour requirements may also have played a part). In addition, farmers also failed to adopt the practice of cultivating alternate strips, of planting permanent crops on alternate strips, of planting short-term crops, and of crop rotation. The observed pattern of adoption suggests that farmers in Pananag looked for immediate cash income and minimal consumption risk, hence preferring to maintain the area cultivated to maize rather than plant perennial crops. Both of these factors suggest that they had a shorter planning horizon than assumed by the SALT model. [ploughing; use of inorganic fertilizer]

Adopters suggested crop-hedgerow competition and "lack of interest" as the main reasons for other farmers not adopting SALT; other major reasons given included religious affiliations, tenancy, and lack of familiarity with the technology. Non-adopters cited a lack of interest and labour issues (i.e., lack of time, laborious technology) as the main reasons for non-adoption, although, as indicated, some mentioned problems with tenancy. A large proportion of both groups also agreed with comments that limited adoption could be attributable to (a) too much work to establish SALT, (b) too long a delay to get benefits, (c) not owning the land, and (d) lack of credit or financial assistance (Table 4). Adopters also suggested that hedgerows and perennials take up too much land. In summary, land ownership, loss of cultivated land area to hedgerows and perennials, labour requirements, and the time required to realise benefits from SALT adoption were thought by farmers to be the major constraints to adoption.

The Impact on the Farming System

Figure 2 is a generalised outline of the processes by which introduced agroforestry technologies (contour leguminous hedgerows and improved livestock breeds, housing and nutrition) affect the farming system, ending with the main objectives of the system (shown in ovals), namely, increased availability of food and cash. The adoption of hedgerows reduces the rate of runoff and soil erosion, which may increase soil fertility directly (or slow its decline), as well as increasing soil moisture. Subsequent formation of terraced alleys increases soil cultivability. Soil conservation measures increase the effectiveness of applying both organic and inorganic fertilisers. Hedgerow trimmings may be applied as green manure to the cultivated alleys or used as a source of fodder for livestock. The use of green manure and organic fertilisers serve to increase the organic matter content of the soil, affecting both soil fertility and moisture-holding capacity. The combined effect of these changes on soil productivity is seen in increased maize yields, hence in food availability. This in turn may reduce the annual expenditure on food. Farmers who adopt a more intensive livestock system are able to capitalise on the improved productivity of the imported stock, together with the fodder produced by the hedgerows, to increase livestock production and sales. This contributes to increased cash availability, as well as increasing the supply of farmyard manure for use on the maize fields. Hedgerow seed may also be sold to increase cash incomes.

What were the effects of adopting SALT in Pananag? Non-adopters operating what was considered to be the traditional farming system reported declining soil depth, soil fertility and moisture content, and declining maize (and other annual crop) yields as a consequence of this resource depletion. In contrast to this, SALT adopters reported decreasing rates of erosion, higher levels of soil fertility and soil moisture, and higher yields (Table 5). The production data confirmed this. SALT maize farmers produced more than twice the output of maize per cropping and per year of non-SALT maize farmers (Table 6). This resulted not only from the larger area cultivated but also higher yields per cultivated hectare. The mean yield for SALT farms was about 50% higher than that for non-SALT farms. The difference was even greater in the more drought prone second crop season, perhaps reflecting improved conservation of soil moisture under the SALT system.

The differences in yields have to be seen in the context of fertiliser use. Eighty six per cent of SALT maize farmers applied fertiliser, whereas only 39% of the non-SALT maize farms were fertilised. Fertiliser rates were somewhat higher for SALT maize farms (28 kg N/ha) than for non-SALT farms (21 kg N/ha). Hence the yield difference between SALT and non-SALT farms may have been attributable to differences in the incidence and rate of fertiliser use, though a regression of yield on fertiliser rate and the presence of SALT did not confirm this. Nonetheless, it appears there was an interaction between fertiliser use and the adoption of SALT. Fertilised SALT farms yielded around 30% more than unfertilised SALT farms, whereas without SALT there was no significant difference between the yield of fertilised and unfertilised farms (Table 6). This suggests that SALT enhanced the effectiveness of fertiliser applied, perhaps providing the incentive for the higher incidence and rate of fertiliser use on SALT farms.

Increases in soil fertility and yield were attributed by farmers to the addition of hedgerow trimmings, which in turn led to decreasing use of inorganic fertilisers (Table 5). While this accords with the theory of SALT, under the modified SALT system used by adopters in Pananag, the relatively wide hedgerow spacing and the limited frequency of trimming imply that the quantity of biomass being applied as a green manure/mulch in the alleys was limited. This may have limited the system's direct contribution to improving soil fertility and soil moisture. It is unlikely that the application of organic fertilisers and hedgerow trimmings was sufficient to sustain production in the long term without the continued addition of inorganic fertiliser (which was counter to the SALT ideal).

The more plausible explanation, then, for the impact of the modified SALT system on maize production is that contour hedgerows reduced runoff and erosion, resulting in increased retention and hence effectiveness of applied inorganic fertilisers, as well as greater moisture retention, particularly during the second cropping. Hence, while SALT adoption in Pananag conserved soil resources, increased maize yields, and increased incomes, these effects were not necessarily a direct outcome of utilising SALT in the way recommended by the MBRLC.

Apart from improved maize production, the major effect of SALT adoption in Pananag was increased cash income from the production and sale of legume seed (Table 7); 40 of the adopters earned an income from such sales, with an average income of P6,000 per year, contributing an average of 30% of the household's annual cash income. It was interesting to note that the majority of farmers who were not cultivating their SALT plots were actually fallowing their land and allowing their hedgerows to go to seed so as to secure a cash income from their sale.

Improved breeds of goats and, and to a lesser extent, the use of fodder from leguminous shrubs, led to an increase in the number and quality of livestock sold and thus also resulted in higher incomes for adopters.

Higher incomes derived from legume seed and livestock led to improvements in the cultivation of maize, annual field crops and vegetables, and cash perennials, primarily as a consequence of purchasing inorganic fertiliser and other chemical inputs. Higher maize yields were associated with greater sales (especially during the first cropping) but not with the attainment of self-sufficiency. Improved annual and perennial crop production enabled adopters to obtain much higher incomes from these sources than non-adopters.

Discussion

As the survey has shown, adoption of SALT is characterised by incomplete implementation relative to the ten-step SALT guidelines promoted by extensionists. Rather than viewing such farmer modification or adaptation as failure, the MBRLC views any adoption of contour hedgerows, regardless of modifications (e.g., wider hedgerow spacing, use of single hedgerows, lower trimming frequency, lack of or infrequent mulching or return of animal manure, failure to cultivate perennials in every third alley, failure to practise crop rotation, fallowing of SALT plots) as contributing to soil erosion control and enhancement of soil fertility, and hence as successful adoption.

While identifying farmer adaptation of SALT as successful adoption is reasonable in terms of meeting the broad objective of soil conservation, such responses also indicate ways in which SALT can be made more acceptable. There is scope to identify how farmers in different communities modify SALT in response to their needs and so to develop variations of SALT with a better fit to specific circumstances. Extension would then take on a more flexible approach in which the basic SALT concept is retained but modified in detail to suit farmers' needs and priorities. For example, in Bacungan, another MBRLC extension site, fallowing SALT plots and cutting the woody legumes at one or two year intervals, followed immediately by a single crop of maize, has allowed households to obtain high cash incomes from the sale of firewood while also obtaining the benefits of soil conservation and increased maize yields from the modified SALT system.

As illustrated by Figure 2, SALT is a complex system which can enhance food production, resource conservation, and income generation by virtue of the interactions between various system components. However, as this study has shown, differences in farmers' goals and circumstances may result in modified SALT systems in which not all the interactions identified in Fig. 2 are operative. The conclusion is that if multiple uses threaten the effectiveness of the SALT system, farmers need to be encouraged to diversify the system so as to cater for all uses. For example, in Pananag, where securing high incomes from seed production has implied foregoing regular trimming of hedgerows and perhaps also retention of a larger number of penned goats, farmers could be encouraged to develop seed production plots so that a regular hedgerow trimming regime could be utilised on SALT plots, the trimmings being applied to the alleys as a mulch or used as a source of forage for goats. Similarly, where wood production is important for the community, the tree component of SALT plots could be more ..ctively promoted at the same time as the alley cropping component was being extended.

CONCLUSION

The case study has shown that the adoption of SALT can indeed provide benefits to upland farmers by conserving soil resources and increasing yields and farm income. Moreover, though small farm size, tenancy, and the lack of a draught animal were clearly constraints to adoption, the majority of farmers in Pananag adopted SALT.

However, this required an intensive extension effort over several years, most adopters learning of SALT through personal visits from a dedicated and competent extension worker. Hence there was little or no spontaneous adoption of SALT by farmers in neighbouring villages.

Further, farmers adopted SALT with substantial modifications, to suit their need for a more immediate return on investment, reduced establishment and maintenance costs, and reduced risk. Because SALT was promoted as a package, these modifications were ad hoc and may not have been the most effective ways to achieve farmers' goals.

It is clear, then, that SALT should be viewed as a preliminary or prototype technology which needs to be adapted to farmers' goals and circumstances, even in the very locality in which it was developed. It should not be promoted as an appropriate technology for all upland environments in the Philippines, despite the pressure from both government and non-government organisations for an off-the-shelf technology for upland development projects.

While this implies that the technology can only be fully developed in specific farms and localities, there is scope for researchers to pursue more of a menu approach, explicitly matching components of the technology to typical sets of farmer circumstances (e.g., where fuelwood or forage is in demand, where land or draught animal power is limiting, where tenancy limits the incentive or the ability to introduce major changes, etc.). This increased flexibility and responsiveness to farmers' goals and circumstances may improve the adoptability and adaptability of the technology, as well as its effectiveness once in place on farmers' fields.

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Table 1. Demographic Characteristics of Households by Adoption Category, Pananag, 1994

Characteristic	Adoption Category		
	Adopters	Non-Adopters	All
Mean Household Size	5.9	5.8	5.9
Mean No. of Residents	5.7	5.6	5.7
Mean No. of Full-time Workers	1.1	1.5	1.3
Mean No. of Part-time Workers	1.9	1.3	1.6
Male Household Head (%)	99.2	100.0	99.6
Mean Age of H/hld Head (years)	42.2	44.4	43.3
Mean Education Level of H/hld Head (years)	4.7	3.8	4.3

Table 2. Distribution of Land Tenure by Adoption Category, Pananag, 1994

Type of Land Tenure	Percentage (%) in Adoption Category		
	Adopter	Non-Adopter	All
a. By household	(n=49)	(n=24)	(n=73)
- Titled land	0	0	0
- Certificate of Land Transfer (CLT)	0	0	0
- Certificate of Stewardship Contract (CSC)	20.4	12.5	17.8
- Tax Declaration	22.4	8.3	17.8
- No formal document	51.0	37.5	46.6
- Communal	2.0	4.2	2.7
- Mortgaged	0	0	0
- Rented	16.3	37.5	23.2
- Others	2.0	0	1.4
b. By parcel	(n=94)	(n=35)	(n=129)
- Titled land	0.0	0.0	0.0
- Certificate of Land Transfer (CLT)	0.0	0.0	0.0
- Certificate of Stewardship Contract (CSC)	22.8	9.7	19.5
- Tax Declaration	19.6	16.1	18.7
- No formal document	46.7	41.9	45.5
- Communal	1.1	3.2	1.6
- Rented	8.7	29.0	13.8
- Others	1.1	0.0	0.8

Table 3. Characteristics of Landholdings by Adoption Category, Pananag, 1994

Characteristic	Adoption Category		
	Adopter (n=49)	Non-Adopter (n=24)	All
No. (%) of land owners	47 (95.9%)	16 (66.7%)	63 (100.0%)
Mean area owned (ha)	3.1	1.2	2.5
Mean area operated (ha)	3.5	1.7	2.9
Mean area owned per capita (ha)	0.6	0.2	0.5
Mean area operated per capita (ha)	0.7	0.3	0.6
Mean no. parcels operated	1.9	1.5	1.8
Mean area per parcel operated (ha)	2.1	1.1	1.7
Mean time from to parcel (mins)	33	20	29

Note: The average area owned by landowners was 3.2 ha for adopters (n=47) and 1.8 ha for non-adopters (n=16).

Table 4. Farmers' Responses to Suggested Factors Responsible for Non-Adoption of SALT, Pananag, 1994

Reason for limited adoption of SALT	Adopters				Non-Adopters			
	Agree	Disag.	Unsure	No Resp.	Agree	Disag.	Unsure	No Resp
There is no need for SALT	1	46	1	1	0	14	1	9
SALT is difficult to learn	1	47	0	1	1	10	4	9
No-one to teach/help farmer	3	47	0	1	1	11	3	9
Cost of materials is too high	14	34	0	1	5	6	4	9
Materials are hard to get	1	47	0	1	4	8	3	9
Too much work to establish SALT	14	34	0	1	7	5	3	9
Too much work to maintain SALT	10	37	1	1	4	6	5	9
Hedgerows take up too much land	14	33	1	1	4	4	7	9
May not get benefits	0	47	1	1	0	11	4	9
Too long to get benefits	8	39	1	1	7	4	4	9
Do not own land - no incentive	10	10	13	16	5	1	6	12
No credit/grant to assist farmer	25	22	1	1	6	5	4	9

Table 5. Adopters' Perceptions of Trends in Various Farm Characteristics, Pananag, 1994

Characteristic	No. of Adopters					
	Increase	Decrease	Same	Don't Know	No Response/ Response not relevant	Avg. years for effect to become evident
Soil erosion	1	44	3	0	1	1.5
Soil fertility	44	2	3	0	0	1.7
Soil moisture	43	3	3	0	0	1.8
Weed problem	7	38	4	0	0	1.7
Inorganic fert. use	0	24	5	1	19	2.2
Organic fertiliser use	5	6	8	0	30	1.4
Crop response to fert.	15	3	7	1	23	1.7
On-going labour req.	12	21	15	0	1	1.2
Output of maize	31	3	8	2	5	1.5
Yield of maize	29	4	8	2	6	1.8
Prod. of annual crops	25	0	7	6	11	1.6
Prod. of perennials	16	0	11	7	15	1.5
Prod. of livestock	20	6	14	4	5	1.5
Farm income	37	2	8	1	1	2.1
Freq. of cropping	5	5	15	1	22	1.7

Table 6. Maize Production Statistics by Conservation Measure and Fertiliser Use, Pananag, 1993

Characteristic	SALT Maize			Non-SALT Maize		
	No Fert.	Fert. Used	All	No Fert.	Fert. Used	All
a. No. cultivating maize	6	31	37	19	12	31
b. Avg. tot. area planted to maize and hedgerows (ha)	1.1	1.2	1.2	-	-	-
Avg. net area planted to maize (ha)	0.9	1.0	1.0	0.6	0.7	0.6
c. Avg. % of maize area cultivated under SALT	0.6	0.6	0.6	-	-	-
c. Avg. no. of parcels cultivated	1.3	1.3	1.3	1.1	1.0	1.1
d. Avg. area per parcel (ha)	0.8	1.0	1.0	0.6	0.7	0.6
e. Avg. no. of croppings per year	2.0	2.1	2.1	2.0	1.8	1.9
f. Avg. prod. (kg) per cropping						
- 1st cropping	713	1,109	1,045	558	439	512
- 2nd cropping	577	959	897	382	274	344
- 3rd cropping	750	1,472	1,391	550	295	456
g. Avg. annual prod. (kg/yr)	1,319	2,293	2,135	946	671	840
h. Avg. yield (kg/ha cultivated)						
- 1st cropping	776	1,026	985	791	604	719
- 2nd cropping	670	853	824	496	333	439
- 3rd cropping	1,563	803	888	550	316	457
- all croppings	957	929	909	652	479	607

Table 7. Composition of Average Cash Income by Adoption Category, Pananag, 1993

Source of Cash Income	Respondent Group					
	Adopters		Non-Adopters		All	
	Value (P)	%	Value (P)	%	Value (P)	%
Maize	1,274	6.8	332	4.6	964	6.4
Other Annual Crops	3,190	16.9	724	10.1	2,379	15.8
Coconut	352	1.9	119	1.7	275	1.8
Coffee	2,002	10.6	429	6.0	1,485	9.9
Cacao	127	0.6	4	0.0	87	0.6
Banana	344	1.8	121	1.7	271	1.8
Fruit Trees	132	0.7	372	5.2	211	1.4
Forestry & firewood	32	0.2	0	0	21	0.1
Legume seed	4,920	26.1	27	0.4	3,311	22.0
Livestock	4,234	22.4	598	8.3	3,038	20.2
Farm wages	532	2.8	734	10.2	599	4.0
Other wage work	911	4.8	0	0	612	4.0
Land rent	61	0.3	0	0	41	0.3
Business	484	2.6	621	8.6	530	3.5
Remittances	123	0.7	271	3.8	171	1.1
Other	143	0.8	2,817	39.2	1,022	6.8
Avg. Total Annual Cash Income	18,861	100.0	7,169	100.0	15,017	100.0