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# Extension Service and Farmer Decision Making on New Cropping Lands in East Lombok Indonesia[1]

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## Abstract

*This paper analyses farming systems management on new cropping lands in East Lombok, Indonesia, and its applications for extension. This research was conducted using semi-structured interviews with 41 farmer respondents managing new lands, and 27 key informants representing different viewpoints. A methodology that unifies the real-life choice theory of Gladwin (1980) and personal construct theory of Kelly (1955; 1991) was used to elicit relevant farmer decision information. By focusing on both behaviours and motivation, the approach was found to be effective in both describing farmer decisions and eliciting decision processes.*

*It is concluded that productivity on new lands is low, but not because of lack of experience or irrational decision making by farmers. Contributing factors included deficiencies in water availability, soil structure and fertility, and an inability of research and extension services to provide solutions. These results highlight the need for a farming systems approach to research and extension that is farmer-centric in relation to both objectives and resources.*

**Keywords**: Agricultural Extension, Decision Making, New Cropping Lands, Lombok-Indonesia

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## Introduction

The Government of Indonesia has had a policy emphasis on food security, particularly by increasing rice production, which is expected in turn to improve farmers' welfare (Booth, 1988; Piggot, Parton, Treadgold, & Hutabarat, 1993). One of the strategies implemented to increase agricultural production has been land extensification, i.e. to develop new cropping lands suitable for rice production in at least one of the three planting seasons available within a normal year. Nearly 8000 ha new cropping lands were developed between 1979/1980 and 1995/1996 in Lombok Island, in Eastern Indonesia, and further significant land development is planned. Most of this land development occurred in East Lombok (OAFC WNT, 1995).

The policy of increasing agricultural production and farmers' income has been supported by other forms of farm assistance including provision of extension services and access to various credit schemes. Extension workers are expected to help farmers in dealing with both technical and market knowledge issues, but anecdotal evidence suggests there has been little contact with farmers on the new cropping lands, despite the recognition of issues of low productivity. Reasons for this deficiency are unclear; possible explanations include (a) a shortage of extension resources, or (b) extension services are not perceived as relevant to farmers' needs.

This paper describes aspects of a study into the farming systems of East Lombok that was designed to provide deeper understanding of productivity and profitability issues of 'new' cropping lands. Three specific research aims were identified: (i) documenting the productivity of new cropping lands in East Lombok; (ii) identifying factors constraining productivity; and (iii) proposing strategies for improving productivity. Achieving these aims was seen to involve documenting available farming resources and activities, farmer objectives and decision-making processes, and farmer perceptions of problems and constraints, prior to formulating remedial strategies.

Following a brief review of the decision research literature, from which emerges an innovative combination of two well established approaches that was developed for this context, we set out relevant contextual information including biophysical, social and extension services details. Results presented include brief details of the farming population surveyed, and depict models of farmer crop-choice decision making, that have utility both as descriptive and predictive devices, that were developed during the research process. These models are then used to help explain why farmers make little use of extension services in making such decisions, and finally to examine the lessons that can be learnt from this finding.

## Decision Theories

Theories of decision making have been categorised into a disciplinary spectrum ranging from economic to psychological (Hammond, McClelland, & Mumpower, 1980). Economics-based theories focus on rational choice between alternatives with multiple attributes, and could be seen to be normative in that they prescribe what people should do i.e. how to make decisions under conditions of risk and uncertainty. An example is Decision Theory, a mathematical approach that incorporates processes to quantify probabilities of possible outcomes and subsequent utility of competing alternatives, to facilitate making satisfaction-maximising decisions (Corander, 2003; Gomez-Limon, Arriaza, & Riesgo, 2003; Keeney & Raiffa, 1976; Marschak, 1978). Psychological theories focus on what people actually do, and underlying thought and judgment processes. For example, Attribution Theory (Curhan, Neale, & Ross, 2004; Kelley, 1973; Rehman et al., 2003; Zeelenberg, van der Pligt, & de Vries, 2000) deals with the 'psychology of

common sense', and describes human behaviour in response to internal and external forces, and focuses on problems of causal attribution. Many theories fall between the two extremes, and include influences from both economic and psychological perspectives. Behavioural Decision Theory (Edwards, 1961; Einhorn & Hogarth, 1981), Psychological Decision Theory (Kahneman & Snell, 1997; Kahneman & Tversky, 1972, 1973, 1979, 1992), Social Judgment Theory (Brunswik, 1952; Feldman, 1996; Hammond, 1966) and Information Integration Theory (N. H. Anderson, 1972; Lien, 2002) all recognise, in various ways, that human behaviour does not meet the pure rationality requirements of Decision Theory, and acknowledge the importance of individual perception, cognition, and preference in forming judgments and decision making.

*Decision Theories Relevant to Farmers, and in Developing Countries*

In the context of rural and farm management decision-making, the literature falls broadly into the three disciplinary groupings of agricultural economics, farm management, and rural development, but there is typically an economic or profit focus. Consequently, the agricultural economics disciplinary contribution, based on Decision Theory, has emphasised rational choice and utility maximisation (D. P. Anderson, Wilson, & Thompson, 1999; J. R. Anderson & Dillon, 1992; Cramer, Jensen, & Southgate, 2001; Hardaker, Huirne, & Anderson, 1997). The farm management discipline has focused more on the tension between profit and risk, and on devising risk-reducing strategies (Kay & Edwards, 1994; Makeham & Malcolm, 1993). Both disciplines have a normative thrust. In contrast, the rural development literature has a focus on describing and explaining what farmers do, and is therefore based on positive analyses. One of the seminal workers in this field is Gladwin (1977; 1979; 1979; 1980; 1989), whose Theory of Real-Life Choice has been shown to be effective in both describing and predicting farmer decision making in both developed and developing country contexts. Among other applications, Gladwin demonstrated that the theory typically models successfully 85 to 95% of choice made by individuals, such as market decisions of Ghanaian fish sellers (C. H. Gladwin, 1975), Guatemalan farmers' cropping decisions (C. H. Gladwin, 1980). Gladwin's work is based in Psychological Decision Theory, and draws on the allied theories of 'elimination by aspects' (Tversky, 1972) and 'preference trees' (Tversky & Sattah, 1979). This theory was selected as promising an effective way of developing an understanding of farmer decision-making in East Lombok.

*Theory of Real-life Choice*

The theory proceeds from the observations that people need a simple procedure to make decisions, and tend to compare alternatives rather than ranking options. In order to overcome cognitive constraints, decision making proceeds through two stages: (1) an 'elimination by aspects' stage, often rapid, informal and even subconscious, in which the number of alternatives is reduced to a manageable number by eliminating those that fail to meet certain major criteria (e.g. specific crops' requirements for water, capital or labour); and (2) a decision tree or preference tree stage in which surviving alternatives are directly compared through a succession of personal preferences such as potential of different crops for satisfaction of family food needs, relative profitability, and relative riskiness.

The theory of real-life choice has successfully provided models of how decision-making occurs in both rural and urban settings, and in both developing and developed country contexts. However, it does not explain why people behave in particular ways, as it focuses on behaviour rather than motivation. One well-established

theory, which does this, is the Personal Construct Theory of Kelly (1955; 1991).

*Personal Construct Theory*

This theory postulates that people's "processes are psychologically channeled by the way in which they anticipate events" (Kelly, 1955, p. 46). In other words, their motivation and behaviour are led by expectations of the future (Murray-Prior, 1998). Such expectations are determined by their individual construct system, through which they interpret the world (make sense, discern patterns, establish order in the complexity of their life) and make predictions about future events and outcomes of decisions (Murray-Prior, 1998). The theory has been demonstrated to provide powerful insights, through eliciting relevant constructs from decision makers, into understanding their perspectives, in both a developing country context (Briggs, 1985) and a developed country context (Murray-Prior, 1994, 1998; Murray-Prior & Wright, 2001).

The complementarity of the approaches offered by the two theories provided justification for attempting to combine both in this study. Gladwin's real-life theory approach provides a framework in which complex decisions can be structured, simplified and analysed. Kelly's construct theory provides insights into the importance of individual values, experiences and expectations in relation to such judgments.

## Methods

This study employed both qualitative and quantitative methods, based around in-depth semi-structured face-to-face interviews (N. H. Anderson, 1972; Babbie, 1990, 2004; Neuman, 1997). The focus of the questioning was on farmer decisions and practices, within a contextual framework of farmer objectives and farm resources, in regard to new cropping lands in East Lombok. The qualitative semi-structured approach was fundamental to exploration of the 'what' and 'why' of farmer decisions processes, and the subsequent development of generic explanatory decision pathways. Two groups of stakeholders were identified: (i) farmers; and (ii) key informants (researchers, extension workers, market agents). Four villages were selected that would provide variety in geographical features and land development timeframes. The villages include Mamben Lauq and Karang Baru (in Aikmel District), Sambalia (in Sambalia District), and Pringgasela (in Masbagik District). A sub village was chosen within each village, based on information provided by the village leader on where new cropping lands had been developed in the selected years. Respondents were selected at random from those identified by the village leader to have been in control of 'new' land since its development, and for their availability for interviews. In total, 41 farmers were sampled (10 out of 18 farmers in the Village of Mamben Lauq; 10 out of 31 in Karang Baru; 14 out of 76 in Sambalia; and 7 out of 7 in Pringgasela). Information required fell into four categories: (i) biographical; (ii) resource details; (iii) farm management practices (crop types and areas, husbandry practices, annual cycle of events); and (iv) farm management processes (decision-making, objectives, crop choice determinants, sources and uses of information, and perceptions of problem issues).

In addition to the use of secondary (literature) sources, supplementary information was obtained from interviewing 27 key informants. Semi-structured face-to-face interviews were used, with questions tailored in each case to the area of expertise of individual respondents, who included land development officers, village and sub-village leaders and water distributors, extension workers, local and non-local traders, crop market experts, agronomists and soil scientists.

*Agricultural Climate in East Lombok*

Climatic conditions strongly affect agricultural production systems practised by farmers in the region. The climate in East Lombok is tropical with two distinct seasons, namely the 'wet' and the 'dry' seasons. The wet season starts in November and ends in March (Table 1). Maximum daily temperatures range from 25-34$^{o}$C and minimum temperatures range from 13-26$^{o}$C.

Table 1

*Average Monthly Distribution of Rainfall in East Lombok 1975-1994*

| | Months | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
| Mm | 272 | 225 | 186 | 79 | 45 | 35 | 30 | 15 | 32 | 53 | 138 | 184 | 1294 |
| Days | 15 | 13 | 11 | 5 | 3 | 3 | 1 | 1 | 2 | 3 | 8 | 10 | 75 |

*Note*. Adapted from "Recapitulation of rainfalls in East Lombok 1975-1994 (In Indonesian: Rekapitulasi curah hujan di Lombok Timur 1975-1994)," by OAFC EL, 1995, Selong: Office of Agriculture of Food Crops of East Lombok.

*Administrative Structures*

In Lombok society a neighbour group consists of 20-50 households, a sub-village comprises 5-15 neighbour groups, and a village contains around 10 sub-villages. A district contains about 10 villages, and there are 12 districts in East Lombok. There is a head person for each of these administrative groupings. In rural areas, selection comes from within the grouping by consensus rather than formal voting. With the position come certain powers to allocate some available farming land to individuals. Approaches to interview individuals for research purposes need to be made through the head persons. This was the only way in which to access individual respondents. Whether this requirement led to selection of biased respondents is impossible to tell. However, there was no evidence of direct interference, by village leaders, in responses gained from selected farmers. Furthermore, the policy of seeking at least 10 respondents in each village at least ensured a wide selection of viewpoints was canvassed.

*Agricultural Extension Systems*

Throughout rural Indonesia the Government administers the agricultural extension system. Its purpose is to transfer new technology from research stations to farmers. It is typically based on the training and visit (T&V) systems whereby extension workers are trained in new technologies, and they then visit farmers and train them (Arboleya & Restaino, 2004; Benor, Harrison, & Baxter, 1984; Dejene, 1989). On occasions, demonstration plots are set up to help convince farmers that the technology is appropriate and worthwhile. Thereafter, the extension officer will visit farmers on a regular basis to advise and instruct.

Prior to 1990, in East Lombok, there was only one extension officer for every two villages. However, since that time there have been enough extension workers for each village to be serviced by two workers. In 1990 an attempt was made to introduce a system whereby extension officers became specialists in particular fields. However, in 1996 this policy was reversed and each officer is now responsible for matters relating to food crop husbandry, animal husbandry, fisheries, plantation crops and forestry. Thus they are expected to be generalists capable of providing advice on a wide range of topics and issues.

*Farming Systems*

A wide range of crops is grown. There are potentially three cropping seasons

per year, depending on moisture availability. Rice, the staple food, is typically grown first, in the wet season, with other secondary food crops following in subsequent seasons such as corn, sorghum, cassava, sweet potato, soybeans, peanuts and mungbeans, a variety of annual fruits, and vegetable crops including chili, garlic, onions, eggplant, longbeans, cucumber, and tomatoes. All crops but rice are multiple cropped. Farmers apply this crop diversification policy to reduce risk of production failure or price drop of certain crops. The limited information available for farmers regarding prices received suggests substantial within- and between-year variation.

Table 2

*Yield of Some Crops Grown on New Cropping Land and Average of East Lombok*

| Crop | New Land (NL) (kg/ha) | East Lombok (EL) (kg/ha) | NL/EL (%) |
|---|---|---|---|
| Wetland rice | 2374 | 4552 | 52 |
| Dryland rice | 1048 | NA[1] | NA |
| Garlic | 6775 | 13006 | 52 |
| Chili | 557 | 1925 | 29 |
| Mungbean | 348 | 579 | 60 |
| Corn | 1317 | 1785 | 74 |
| Longbean | 1500 | 859 | 175 |
| Soybean | 167 | 1037 | 16 |
| Peanut | 579 | 1044 | 55 |

*Note*. [1]Data not available.

Physical productivity of new cropping lands is low. This was confirmed through the comparison of productivity of the lands to average productivity of East Lombok, which is contributed primarily by old established cropping lands (Table 2). Except longbeans, crops grown on new cropping lands produced at least 26% lower than average regency figure. This low productivity was due to many constraints on new cropping lands, particularly of insufficient water to irrigate farms and shortage of farmers' working capital to finance their farm activities. Both of these limited farmers' capacity to apply improved farming practices, resulting in less use of agricultural inputs, especially fertilizers.

In term of income, calculated here as gross margin (GM) per hectare, i.e. total production value minus total variable cost, some crops performed better than other crops (Table 3). One feature of those cropping programs was that few farmers were growing high income crops because of the constraints encountered (crop selection processes are discussed in the section of 'farmer decision making').

Table 3

*Gross Margin (GM) and Farm Cost (FC) Per Hectare of Crops or Crop Combinations Grown on New Cropping Lands*

| Crop or crop combination | GM (IDR 000) | *N* | R | FC (IDR 000) |
|---|---|---|---|---|
| Garlic | 5660 | 4 | 1 | 2446 |
| Chili+tobacco+peanut | 3476 | 1 | 2 | 428 |
| Chili+corn | 3248 | 1 | 3 | 178 |
| Chili+onion | 2069 | 1 | 4 | 1731 |
| Chili+tomato | 2024 | 1 | 5 | 376 |
| Pandanus | 1762 | 3 | 6 | 50 |
| Chili+tobacco | 1547 | 11 | 7 | 405 |
| Cassava | 933 | 2 | 8 | 31 |
| Chili+tobacco+cassava+longbean | 790 | 1 | 9 | 237 |
| Onion+longbean | 723 | 1 | 10 | 1367 |
| Chili+peanut+longbean | 647 | 1 | 11 | 293 |
| Wetland rice | 572 | 28 | 12 | 442 |
| Chili+soybean | 543 | 1 | 13 | 411 |
| Tobacco | 354 | 1 | 14 | 66 |
| Cane | 351 | 3 | 15 | 155 |
| Corn+cassava | 333 | 1 | 16 | 317 |
| Chili | 234 | 5 | 17 | 160 |
| Peanut | 229 | 2 | 18 | 155 |
| Chili+tobacco+garlic | 213 | 1 | 19 | 412 |
| Corn | 205 | 16 | 20 | 169 |
| Redbean | 182 | 1 | 21 | 31 |
| Mungbean | 179 | 8 | 22 | 73 |
| Soybean | 148 | 2 | 23 | 277 |
| Corn+peanut | 138 | 2 | 24 | 195 |
| Dryland rice | 138 | 25 | 25 | 146 |
| Sweet potato+cassava+corn | 68 | 1 | 26 | 7 |
| Sweet potato | 41 | 2 | 27 | 8 |
| Corn+longbean | -2 | 2 | 28 | 79 |
| Longbean | -126 | 1 | 29 | 199 |

*Note. N*: Number of farmers; R: Ranking (of crop by GM).

## Results

*Farmer Profiles*

In all cases the farmer respondents were males, reflecting that this is a traditional Muslim society where men take responsibility for farm decisions. This is quite similar to finding of Squire (2003) in his study of women participation in sustainable agricultural development in sub-Saharan, Africa, where men took leading role in most farm decisions. Respondent age ranged from 29 to 88 years, with a mean of 51. More than one third of the farmers were older than 60 years. The average farming experience was 34 years. The average education was 4.4 years, ranging from 0 to 12 years. Only 15% had completed senior high school (12 years) and 44% had received no formal schooling. There was a small but statistically significant negative association between age and level of

education (regression coefficient –0.12, $r^2$ = 0.13, $p$=0.02).

All farmers possessed new land as private property (as a consequence of sample selection). Three were also cultivating land of other status. These alternative systems of land occupation included rental for a fixed sum, crop sharing, and the *gadai* system whereby a farmer borrows money and the lender acquires cultivation rights to a parcel of land until the loan is repaid. Seven farmers also had 'old' land (cropped prior to implementation of extensification policies) and 15 farmers had other types including undeveloped land, garden and shifting cultivation land.

The average area of new land was 1.03 ha but with considerable variation both between farms (0.2 – 5.0 ha) and between the villages (0.5 – 1.5 ha). For the seven farmers who also owned old cropping land, the average area of this type of land was 0.3 ha. The average area of all lands (new, old and other lands) was 1.3 ha.

Most farmers (63%) owned livestock of some type, with 56% owning cattle, 37% poultry, 7% goats and 5% horses. Cattle are regarded as particularly valuable and serve several purposes including provision of draught power, as a source of income, and as a form of saving in a society where bank accounts are unusual. Herds averaged 2.4 head (range 1-9) in size and ranged in estimated value from IDR 150,000 to IDR 12,000,000 or US$ 63 to US$ 5,078 (US$ 1 = IDR 2,363).

No farmers used any form of mechanisation on their farms. The busy periods of the year are at planting (especially for rice) and harvesting. At these times farmers rely on casual non-family labour, which is readily available. At other times of the year permanent family labour is often under employed.

*The Use of Extension Advice by Farmers*

Extension officers have work guidelines that broadly cover technical and market (price) information for common forms of production. They transfer government recommendations and information from research stations to farmers.

In relation to types of land, extension workers focus more on 'old' land, where irrigation water and distribution infrastructure is more readily available than for 'new' cropping land. This is apparently predicated on the belief that if irrigation is sufficiently available, agricultural technology (such as fertilising) can be applied more easily and consistently, and with high probability of production improvement. Consequently, extension workers spend little time on the new cropping lands, and even if they do visit 'new' farms, farmers do not readily accept their advice. The use of extension services on new cropping land has been very limited.

Most farmers (66%) stated that there are no government recommendations to be applied on their new cropping lands. Another 12% did not know whether or not there were any recommendations. The remainder (22%) was aware of government recommendations from extension workers, but only one third of these (7%) applied any of their recommendations.

There are three types of recommendation available for the new cropping lands, but the only one applied by the farmers was to grow rice during the rainy season, and with other crops to follow. Three farmer respondents applied this recommendation because they thought that it was appropriate given the water situation on their farms. However, in reality nearly all farmers were following this strategy of rice followed by other crops, not because it was a recommendation, but because it was seen as being the obvious thing to do.

The second recommendation, to plant rice with individual plants exactly the same distance apart, using a special distance meter, was known by only three respondents. However, none of them applied it because the technique requires a lot of

work, time and cost, and there was a perception that it may be ineffective in any case.

The recommendation to apply balanced fertiliser on rice, i.e. 300 kg Urea, 100 kg TSP (Triple Super Phosphate), and 75 kg KCl (Potassium Chloride) per hectare was known by only three farmers, but ignored due to lack of capital.

In brief, even in situations where farmers were aware of the government recommendations for the new cropping lands, recommendations were ignored because they require extra expenditure and time, the techniques were not convincing in terms of producing better results, and the farmers faced the problem of lack of capital. This phenomenon is similar to that found by Fujisaka (1993; 1994), who investigated why farmers of Southeast Asia did not adopt recommendations, and found that farmers often have rational reasons related to cost, time, or biophysical aspects of the farming system. Similarly, Dorward (1996; 1999) found that poor farmers in Malawi fail to adopt new maize varieties because they lack supporting credit. In addition, one of the findings by Ajayi et al. (2003) revealed that farmers may adopt improved fallows if there are appropriate and conducive policy and institutional incentives.

Market price information is obtained mainly (78% of farmers) from traders or outside buyers who come frequently to the villages. The farmers usually compare the prices offered by three buyers before deciding to sell at a certain price. Other sources used were, in descending order: direct visit to the market place (32%); neighbours (12%); radio (5%) and television (2%). No farmer sought market information from printed media or from extension officers.

Technical information on farming practices was obtained from the farmers' parents (63%), neighbours (31%), extension officers (24%) and the reading of brochures (7%). Information from neighbours was sometimes obtained by direct communication and sometimes by observation. This evidence suggests that although extension officers were present in all villages, most farmers were not convinced of the value of their advice. Furthermore, most of the farmers using extension officers were in one village, Mamben Lauq. It became apparent during the survey in this village that many farmers had family connections with each other, e.g. through marriage, and they liked to attend extension activities together.

This less use of information from extension agents in this or other developing countries contrast the phenomena in advance countries, where farmers actively seek advice and even are willing to pay for services provided by extension agents (see e.g., Byrne, Kelly, & Ruane, 2003).

*Farmer Decision Making*

This study indicated that farming objectives of the farmer respondents were strongly economic, either directly or indirectly (Table 4). Only five of the eighteen stated objectives elicited through interviews were non-economic in character, and the frequency with which they were mentioned placed them no higher than sixth place. The three main objectives, which dominated all others, were to fulfill the family's basic needs of food, clothing and shelter, to finance children's schooling, and to undertake a pilgrimage to Mecca (Saudi Arabia).

Table 4

*Farming Objectives Identified by Farmer Respondents*

| Objective | % |
|---|---|
| Fulfill family's basic needs | 56 |
| Finance children's education | 56 |
| Pilgrimage to Mecca | 49 |
| Have or add income or investment on livestock or land | 15 |
| Build a house (or a better house) | 12 |
| Provide working place for children | 12 |
| Donate to development in the community or help other people | 7 |
| Have leisure time | 5 |
| Pay or avoid debt | 5 |
| Make use of spare time | 2 |
| Substitute marketing activity | 2 |
| Have a simple job | 2 |
| Avoid stealing | 2 |
| Finance the next farm activities | 2 |
| Continue parents' traditions | 2 |
| Have increasing income | 2 |
| Buy a motorbike (for business use) | 2 |
| Seek profit | 2 |

*Note*. Total percentage is more than 100 as some respondents provided more than one response.

As Moslems, the farmers are obliged to undertake a pilgrimage to Mecca once during their lifetime if they are financially and physically able to do so. Accordingly, it is likely that additional farmers, beyond the 49% who stated it as an explicit objective, would have this as a long-term objective. However, given their current struggle to meet basic family needs, it may have been considered unrealistic and therefore was not mentioned.

As shown in the section on climate, the farming systems on the new cropping lands on East Lombok are highly seasonal. Accordingly, the farmer decision processes are analysed here on the basis of planting seasons. Authors built intuitively the decision trees in the figures presented based upon farmers' responses and their revealed constructs when they were asked to provide reasons for selecting particular crops they were growing and for not selecting other crops (or for not planting their lands) at the season. The number of farmers following each path in each figure was counted from planting programs that individual farmers applied on their farms in each season.

It is apparent that in the first planting season farmers grow rice almost exclusively (90% farmers). This decision to grow rice is influenced strongly by environmental conditions, in particular the difficulty in growing other crops during this rainy season. While rice is suited to excessive water availability, other crops may be easily spoiled by the existence of high moisture. Accordingly, if the land is available to be cropped, and not still carrying a crop from the previous season, then farmers planted rice. The choice between wetland and dryland rice is determined by whether or not the land is suitable for wetland rice, and whether there is likely to be sufficient water. Some of the farmers who grow dryland rice do so because of previous crop failures with wetland rice. In other words, farmers grew wetland rice as much as they could, and were rationally driven by higher production

per hectare (2,374 kg > 1,048 kg). The decision pathways for the first planting season, together with the number of farmers following each path, are shown schematically in Figure 1.

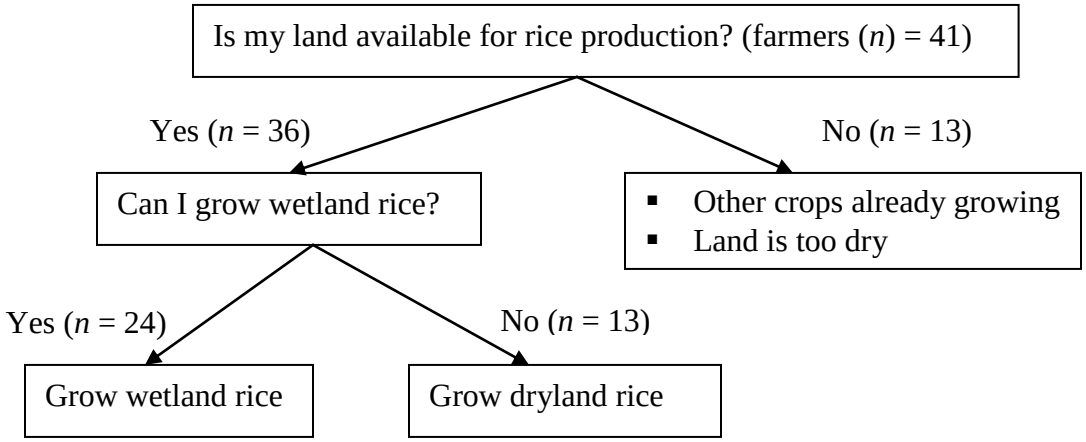


*Figure 1*. Farmers' decision model for the first planting season on new cropping lands. *Note.* Number of farmers following both paths in total is more than the total farmers because some farmers have followed different pathways for different fields.

It is apparent that decision making in the second and third planting seasons is much more complex than for the first season. This is because, as long as there is adequate water, there are a lot more crop alternatives. The first decision that farmers have to make in regard to these planting seasons is whether the land is available for cropping. Land availability is determined by whether or not the previous crop has been harvested, and whether or not there is likely to be sufficient water. This is shown schematically in Figure 2.

The process of choosing the particular crop to grow is complex. Clearly there are many considerations that farmers take into account, as indicated by the considerable diversity of reasons as to why farmers grow or do not grow particular crops. Further, the range of crops available to farmers is considerable. The crops that are finally chosen differ both between farmers and between villages, and this would appear to reflect both differing environmental conditions and different farmer perceptions of expected profit and risk. It would seem that most farmers tend to choose the same crops as the previous season as long as they are satisfied with the previous returns. However, there is also an ongoing element of searching for better alternatives. It is notable that all farmers have grown more crops than those they are currently growing. All farmer respondents had experienced growing at least four kinds of crops, most had grown six to eight crops, and some even with more than ten crops. Rice was the most familiar crop.

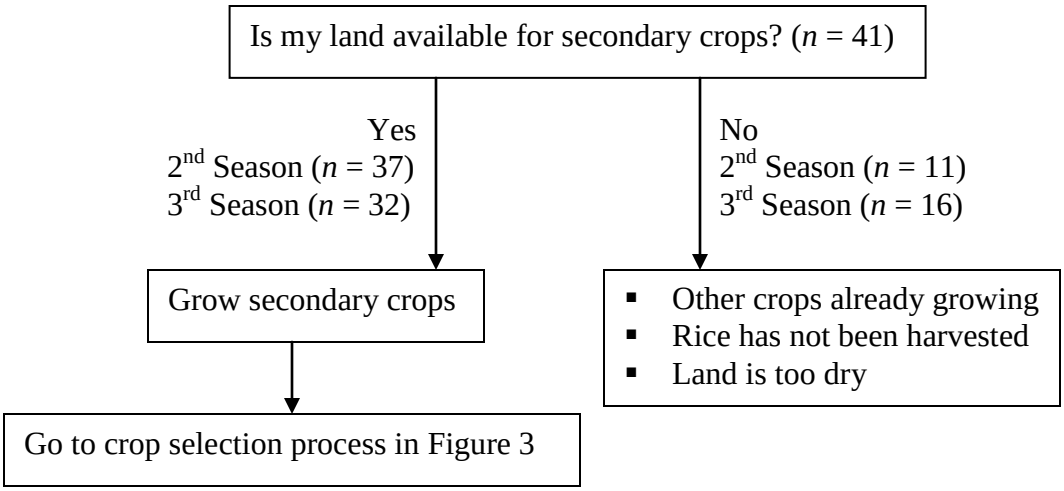


*Figure 2*. Farmers' decision model for the second and third planting seasons on new cropping lands. *Note*. Number of farmers following both paths in total is more than the total farmers because some farmers have followed different pathways for different fields.

The process to choose the particular crop can be depicted as a three-stage process (Figure 3). The first is a decision by the farmer as to whether he is satisfied with the choices made in the previous year. This information was obtained by comparing the current cropping programs and the farmers' plans for the next year. Respondents were questioned on why they planned to change or not change their cropping programs for the subsequent year.

The second stage is to eliminate all those crops that for various reasons are non-feasible due to inadequate resources. A deep inquiry was again placed upon farmers' reasons for selecting particular crops and why not other crops. This process is similar to **elimination by aspects** in stage 1 of **Real-life Choice Theory** of Gladwin (1980). The most important of these resources is water, but in some situations lack of capital, knowledge, labour, or market demand may also be constraints. If farmers thought that water would not be sufficient to support crop growth then farmers would eliminate those crops directly, and so on. This process of elimination is largely done as a subconscious process (H. Gladwin & Murtaugh, 1980).

The third stage of the decision process is to choose between the feasible crops. Given there was more than one crop that could be grown after the crops could pass all constraints recognized by farmers, farmers were interviewed with their reasons for opting for a certain crop and not others. This would appear to involve a trade-off between expected profit and risk. Farmers' revealed reasons were mostly one-sided, in that they either selected a crop due to its higher profit potential or they rejected a crop for its high production or market risk. However, individual farmers have to make these decisions based on limited information, and hence they have differing perceptions as to both income and risk. The finding of this last stage of decision making process appears to be similar to the findings in study of girls' selection of educational programs in Swaziland (Dlamini, Ngwenya, & Dlamini, 2004). The study revealed that girls selected science programs for economic reasons of the availability of financial assistance and jobs, while some girls appeared to avoid risk of joining non-traditionally-female programs, which they lacked familiarity.

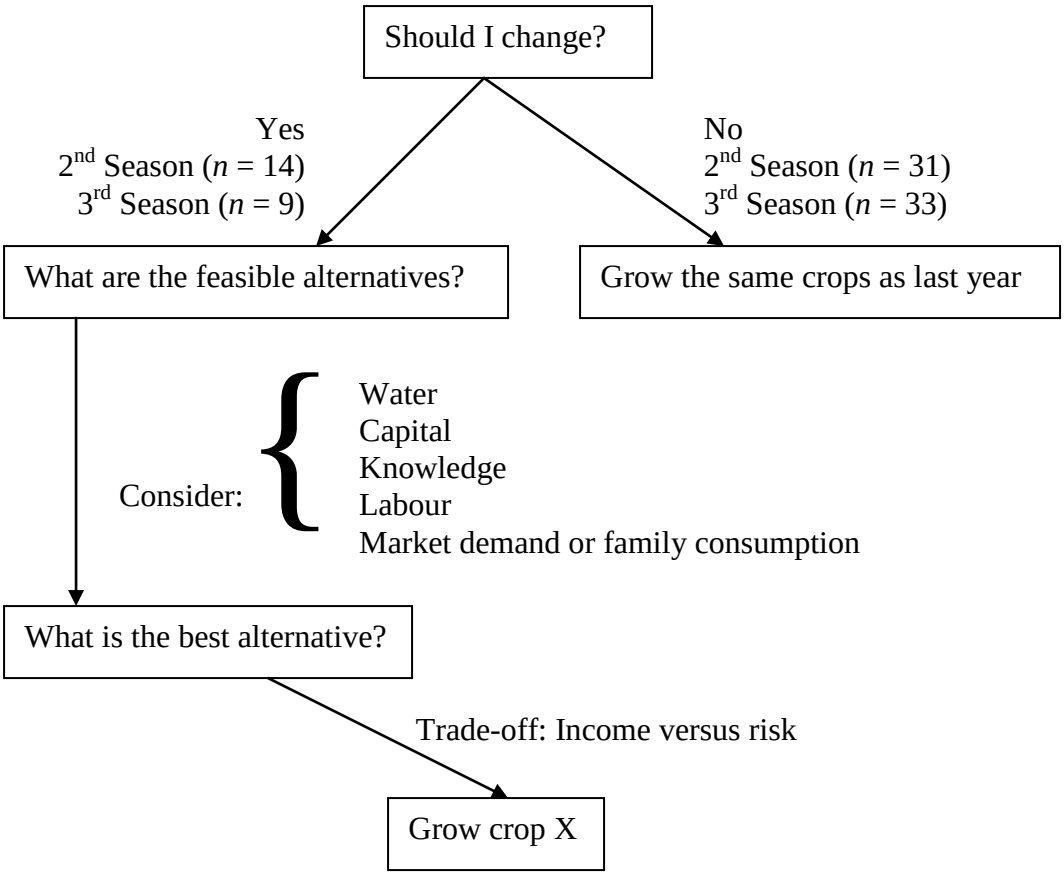


*Figure 3.* Crop Selection Process in the Second and Third Planting Seasons on New Cropping Lands. *Note*. Numbers of farmers (n) recorded following the pathways here is based on the farmers' plans for the following year. Some farmers could not be recorded, because they had not decided their plans, and some farmers followed both pathways.

## Discussion and Conclusion

Gladwin's (1980) theory of real-life choice employed in this research has allowed development of models of farmer decision-making processes. Aspects or constructs that farmers used in making crop choices were elicited using Kelly's (1955; 1991) personal construct theory by inquiring into stake holders' reasons for their behaviours. This facilitates better understanding of farmers thought processes and priorities, and thereby provides guidance for better targeting extension efforts in future. It is evident that the limited use of available extension services by farmers was due to three main reasons:

1. Food and family security could be met by growing the very familiar rice crop for which advice was deemed unnecessary.
2. Capital constraints prohibited use of expensive inputs, such as fertiliser, which were considered to be antithetical to build up of financial reserves for such purposes as a trip to Mecca, education of children, or securing better housing or more farming capacity.
3. Given that there is no evidence of technical research undertaken on these lands, extension officers are not in a position to train farmers in specific, appropriate practices.

This highlights the need for a farming systems approach to research and extension, such that the issues investigated

are relevant to the farming situation, as experienced by the farmers. The basis for this is the finding that the crop choice and input decisions (agricultural recommendations) that farmers were applying appeared to be logical in relation to their personal constructs as determined by their objectives, experiences and information sources (Kelly, 1955, 1991). Farmers were constrained by insufficient water for irrigation and lack of working capital to grow 'better' crops. In addition, alternative crop choices leading to a potentially higher income also involved increases in both financial outlays and perceived business risk, and therefore were seen as irrelevant.

The conclusions to be drawn from this work exist at two levels – the specific and the general. At the **specific level** of the new cropping lands of East Lombok, it is apparent that there is a lack of accord between extension advice and farmer needs and perceptions. For extension to be capable of contributing to increased farm productivity and profitability, this discord needs to be addressed. Greater farmer involvement in definition of farm level problems will facilitate formulation of relevant and applicable solutions. This would require a change in extension orientation from a top-down to a more collaborative and interactive form of communication. For example, better understanding of farmers' construction of a major constraint, such as finance or intermittent water supply, can powerfully inform design of effective solutions.

At the **general level**, there is considerable potential for wider application of the combination of methodologies reported here. Eliciting from farmers' decision making processes, in terms not only of 'how' but also of 'why' is a valuable addition to the suite of technologies available for effectively enhancing agricultural systems in both developed and developing country contexts. The strength of the approach is that it focuses directly on explaining both behaviours and motivations, and also provides an efficient construct for communicating the insights that emerge.

Additional conclusion resulted from this study is that there are other possible ways of improving farmers' income. With regard to the major farm problem of lack of water supply, it appears that irrigation infrastructure needs to be developed or improved such that cropping intensity can be increased, as well as inclusion of more profitable crops (such as wetland rice and garlic) in farmers' cropping programs.

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