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CHANGE, ADJUSTMENT AND THE ROLE OF SPECIFIC EXPERIENCE: EVIDENCE FROM SRI LANKAN RICE FARMING*

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Human capital comprising various components, such as different types of training, experience and skills, influences the capacity of economic agents to adjust to changing environments. We distinguish between formal education, general experience and various types of specific experience as determinants of adjustment to disequilibria in agriculture and demonstrate that their relative importance varies according to the nature of the changes facing the farmers. The results provide strong support for the importance of land-specific experience even in 'modernising' situations.

It has been argued that an economy in a stationary state, where the production technology and the production environment (both physical and economic) has remained unchanged over a long period, will be in an equilibrium with regard to resource use (Schultz 1975).[1] Such equilibria can be disturbed by changes in the economic or physical environment and by technological change. Individual firms do not and, often, cannot instantaneously adjust to such disturbances for several reasons. The rate of adjustment is determined by the ability to seek out relevant technological and market information, decode and analyse it, adapt it to the environment and, finally, to apply this knowledge effectively. Other relevant factors include various costs and lags involved in changing capital equipment.

This ability can be expected to depend on human capital, comprising factors such as education, experience and other skills (Welch 1978). In a farming situation, if there is a change in the economic environment, while the technology and the physical environment remain unchanged, resource allocations require adjustment. Allocative efficiency[2] requires the knowledge of the parameters of the production function as well as market information. Farmers with long experience in the use of a particular technology in a given physical environment can be expected to know these technical parameters. Therefore, the capacity to adjust to disequilibria caused by changes in the economic environment will primarily depend on the ability and skill to decode and analyse *market* information.

However, a change in the technology or the physical environment requires the farmer to understand the parameters of the new production function. Technological change requires farmers to seek,

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[1] Whether traditional agriculture represents such an equilibrium state has been disputed (Lipton 1968).
[2] The terms, economic, allocative and technical efficiency follow the definitions given by Farrell (1957).

obtain, decode, analyse and apply the new technology to crop production. If the technology is sensitive to variations in physical environment across farms, as is often the case, then, the learning of the parameters of the production function and the related 'best practice' techniques takes time since it requires experimentation.[3] Therefore, economic efficiency depends on the farmer's ability to apply the technology most effectively, and his knowledge of the parameters of this production technology (function) is likely to be associated with technical efficiency. Such knowledge is a prerequisite for optimal allocative decisions. Hence, overall economic efficiency can be expected to be strongly correlated with technical efficiency.[4]

In an investigation of a group of Sri Lankan farmers who have been settled in a new irrigation project considerable variations in their technical and allocative efficiencies were observed and they were related to certain farmer attributes including human capital variables (Ekanayake 1987*a*). In this paper, we explore the role of such human capital variables in terms of the above discussion, relating farmers' capacity to apply new technologies to their specific experience in particular agro-climatic complexes.

'Best Practices'

Differences in output among farms that cultivate the same crop using a similar technology may occur due to several reasons. The most obvious among these are the differences in micro-environments across farms and in the quantities of measurable inputs used in the cultivation of a crop. However, even with identical levels of such inputs, outputs may differ due to differences in certain practices such as timing of input applications. Such technical efficiency differences are likely to be substantial at the early stages of adoption and learning of a new technology. It is important to recognise that various alternative methods of input use can have major effects on output but may not be captured in purely quantitative measurements of the inputs.

As such alternative practices or techniques used can result in varying outputs for given levels of quantitatively measurable inputs, a technology defined purely in terms of measurable inputs may not yield a unique functional relationship of inputs and outputs. However, a unique 'best practice' input–output correspondence (a production frontier) may be defined and identified as an envelope of the entire range of relationships. All these, other than the best practice relationship, will be inefficient relative to the frontier production function. In practice, it is difficult and sometimes impossible to identify and measure differences in the quality of inputs. Therefore, Johnson (1965) advocated measuring only conventional inputs, and Samuelson (1965) suggested using only measurable quantitative economic goods and services as inputs in a production function. With only such measurable, 'conventional' inputs, a technology can be defined with best and inferior practices, where the best practice

[3] Information on new technologies in agriculture is typically diffused in the form of packages suitable for broad agro-ecological zones and is expressed in measurable physical inputs such as seed, fertiliser and chemicals, and certain practices to be observed in their application.

[4] Under conditions of imperfect information, in a dynamic setting, it may be optimal for a farmer to be both technically and economically inefficient in the short run.

frontier is an envelope of inferior functions. This enables non-measurable differences in inputs to be captured in a technical efficiency measure where technical efficiency is treated as the deviation from the frontier production.

Human Capital as a Determinant of Technical Efficiency

Education has been the most widely studied component of human capital which has been related to innovation, adoption of new technologies and more generally to economic growth and development. Becker's (1964) pioneering work recognised general training and specific training as important components of human capital. Using these general concepts, many attempts have been made to relate human capital to agricultural productivity (for a review, see Jamison and Lau 1982; Fane 1975; Huffman 1977; Moock 1981).

Apart from a few exceptions (Shapiro and Müller 1977), much of the empirical work in this area has been limited to the exploration of the relation between human capital and average allocative efficiency of a group of farmers. Welch (1970) argued that technical efficiency is solely determined by education. By and large, these studies support the view that human capital (variously defined) has a significant effect on technical and/or allocative efficiency. To the extent that these studies distinguish between specific and general training (or experience), this distinction is confined to farming experience versus other kinds of human capital. However, farming experience itself can be of many different kinds depending on the crops, environment and technology. In a dynamic setting, it would be expected that certain kinds of farming experience would be more relevant to the particular adjustment problem.

Recently, Rosenzweig and Wolpin (1985) used the concept of land-specific experience to develop an explanation for some widely observed phenomena in rural areas of less-developed countries (LDCs). They argued that the predominance of inter-generational family transfer of land, over use of family labour, and scarcity of land sales in traditional agriculture can be explained on the basis of an optimal implicit contract between generations to maximise the gains from land-specific experientially obtained knowledge without having to assume market imperfections. This knowledge is acquired over time by those who cultivate the land on a particular farm. However, they hypothesised that as technological change proceeds, return to accumulated experience diminishes.

The attempt made by Rosenzweig and Wolpin (1985) to test this hypothesis empirically was subject to major limitations.[5] The Indian farm survey data they used did not permit a rigorous and satisfactory test of the hypothesis. In particular, the procedure used (a profit function approach which attempted to test whether land-specific experience raised farm profits in bad years) could not clearly distinguish between different types of experience directly relevant to farming.

[5] The concept that such specific experience may be related to productivity was earlier tested by Moock (1981) in a sample of Kenyan maize farms but statistically significant support from these data was not found.

However, their basic hypothesis is attractive and may even be applicable to modern agriculture where technological changes are pervasive. As mentioned earlier, new technologies also need to be adapted to micro-environments in particular farms. Land-specific experience can enable the choice of the best practices for a given parcel of land so that the movement to the new equilibrium is facilitated. Therefore, *ceteris paribus*, a person experienced in farming the same land over a long period of time is more likely to identify and use the best practices associated with the new technology. Such specific experience also raises output through better knowledge of the parameters of the relevant production function. Hence, we can hypothesise that land-specific experience is likely to raise technical efficiency.

Statistical Model

In this paper, results are presented from an analysis of farm data from Sri Lanka in a situation where farmers were faced with changes in both the physical environment and the farming technology. The particular circumstances obtained here gave a unique opportunity to test rigorously whether land-specific experience influenced farming efficiency.

A frontier production function may be estimated using several alternative methods. This paper follows the parametric statistical approach of Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broek (1977).[6] Until recently, stochastic frontier production functions of this type could not be used for obtaining individual firm-specific measures of technical efficiency. Thus, comparisons of relative efficiency were confined to those between groups, greatly limiting the scope of the analysis. However, recent developments (Jondrow, Lovell, Materov and Schmidt 1982; Kalirajan and Flinn 1983) have enabled this problem to be overcome. A major attraction of this procedure over alternative approaches is that it does not attribute all unexplained variation in the sample to technical inefficiency and permits statistical testing of the hypothesis that observed deviations from the frontier are merely due to random noise (Ekanayake and Jayasuriya 1987). The statistical model of such a production frontier may be written as follows:

$$(1) \quad Y_i = X_i B + E_i \qquad i = 1, 2, 3, \ldots, N$$

where

$$E_i = U_i + V_i \qquad i = 1, 2, 3, \ldots, N$$

Y_i, X_i and B are output, inputs and constants respectively and U_i and V_i are technical efficiency parameter and statistical noise respectively. Note that technical efficiency, as defined, is independent of prices.

Let σ_u^2 and σ_v^2 be the variances of 'U' and 'V' respectively and define $\sigma^2 = \sigma_u^2 + \sigma_v^2$ and $\gamma = \sigma_u^2/\sigma^2$.

[6] Other alternatives are the non-parametric programming approach apparently first introduced by Farrell (1957), the parametric programming approach also proposed by Farrell (1957) and the corrected OLS method of Greene (1980) which yield deterministic frontier functions. For a comprehensive review of the theoretical foundations and empirical procedures for the analysis of economic efficiency, see Fare, Grosskopf and Lovell (1985).

Assuming that U and V are independent, U is normally distributed but truncated at the mean and V is normally distributed, production frontiers can be estimated using maximum likelihood methods (Aigner *et al.* 1977; Battese and Corra 1977).

Ideally, other specifications for the distribution of U should be tested, although in previous work alternative specifications (such as the gamma distribution) have not yielded significantly different results (see Coelli and Battese 1986; Stevenson 1980; Waldman 1984). Our empirical results, therefore, are subject to the limitations imposed by our assumption of the half normal specification for U. Maximisation of the relevant likelihood function, by numerical techniques, gives the maximum likelihood estimates of the production function parameters, the intercept and the input coefficients, σ^2 and γ. We used the Newton–Raphson technique following Battese and Corra (1977) and experimented with a range of initial values for the coefficients, starting with ordinary least squares (OLS) estimates and values for γ between 1 and 0.

Firm-specific technical efficiency estimates are derived from the conditional distribution of U given $(U+V)$.[7] The conditional mean of U_i given (U_i+V_i) is

$$(2)\quad E(U_i/U_i+V_i)=\int_{-\infty}^{\infty} U_i f(U_i/U_i+V_i)$$

where

$$(3)\quad f(U_i/U_i+V_i)=(1/\sqrt{2\pi})\frac{\sigma}{\sigma_{ui}\sigma_{vi}}\exp\left\{-\frac{\sigma^2}{2\sigma_{ui}^2\sigma_{vi}^2}\left[U_i+\frac{(E_i\sigma_{ui}^2)}{\sigma^2}\right]^2\right\}$$

$$\frac{1}{1-F(.)}$$

Therefore,

$$(4)\quad E(U_i/U_i+V_i)=-\frac{\sigma_v\sigma_u}{\sigma}\left[\frac{f(.)}{1-F(.)}-\frac{E_i}{\sigma}\left(\frac{\gamma}{1-\gamma}\right)^{1/2}\right]$$

where E_i is the residual obtained with reference to the estimated frontier production function for each farmer and $f(.)$ and $F(.)$ are the values of the standard normal density function and standard normal distribution function evaluated at the value of the following expression:

$$\frac{E_i}{\sigma}\left(\frac{\gamma}{1-\gamma}\right)^{1/2}$$

If the production function is Cobb–Douglas, then $E[\exp(-U_i)]$ is a measure of technical efficiency which varies between 0 and 1. When

[7] Jondrow *et al.* (1982) and Kalirajan and Flinn (1983) independently showed that a measure of individual firm level inefficiency can be obtained by using an estimate of U conditional on the total disturbance $(U+V)$. The methods of decomposition of the total error (E_i) derived by Jondrow *et al.* (1982) as well as Kalirajan and Flinn (1983) are identical except for a difference in parameterisation as shown in Ekanayake and Jayasuriya (1987).

$E[\exp(-U_i)]=1$, technical efficiency is 100 per cent. These firm-specific technical efficiency measures are used to explore the determinants of technical efficiency variations between farmers.

Data

The data used were obtained from a farm record book survey carried out in Block 313 of System H of the Mahaweli Development Project in Sri Lanka, a major irrigation-cum-settlement project, during the crop year 1984/85. (The data are available from the authors.) System H is in the north-east of Sri Lanka, and has 26 000 small farms. The project commenced in 1970 and will develop approximately 300 000 ha of new land for irrigated agriculture (mainly rice) by 1990 which will double the area of irrigated agricultural land in the island. Farmers from many areas in the country are settled in newly developed land with each farmer being given 1 ha of land. The farmers in Block 313 were first settled in 1977/78.

The entire area of the System can be irrigated during the Maha season, but only a portion can be irrigated in the Yala season.[8] During the Maha season, water is supplied on the basis of a rotation schedule so that the first half of the distributory channel (head) gets water for a certain number of days after which the second half (tail) is supplied for the same number of days. In practice, farmers located in the head have much better access to water throughout the season. Those in the tail have access to water only during their turn and supplies are reduced as water is illegally taken by head farmers.

During the Yala season, a number of distributory channels are selected for irrigation depending on the estimates of water available. As only a part of the land can be irrigated, such irrigable land is distributed among all farmers. Thus, when water is issued to a selected distributory channel, farmers owning land in the tail of that channel (which cannot be irrigated) share equally the land located in the head of distributory channels (which receive irrigation water) with their owners.[9] Thus, the tail farmers move to the head in the Yala season.[10]

The settlers themselves are drawn from different environments and have significantly different backgrounds. The major types are Purana settlers (those who have traditionally lived in the area), settlers selected from the high rainfall region of the country (the wet zone) and others, including those who have previously been squatters and farmers from other dry zone areas.

The sample consisted of 63 farmers from the head of the system and 61 from the tail, selected at random. In the Yala season only 87 farmers cultivated rice while the rest cultivated other crops depending on soil

[8] Agricultural development under the Mahaweli Development Project (including System H) takes place in the dry zone of Sri Lanka. The dry zone is the area in the island which receives less than 75 inches of rainfall annually. It has two seasons: the Maha season during which most of the annual rainfall is received and the Yala season during which there is little rain.

[9] This system of water and land sharing is an adaptation of a traditional practice in village tanks in the dry zone of Sri Lanka (see Leach 1980).

[10] The farmers who move to the head in the Yala season do not get the same allotment in each Yala season since the actual location irrigated is also rotated depending on the water availability in each season.

type. Cobb–Douglas production frontiers[11] were fitted for those farmers cultivating rice. Likelihood ratio tests were carried out for all locations together as well as for the different pairs. They indicated that pooling of the data would be inappropriate (Ekanayake 1987*b*). Separate functions were fitted for the head and the tail for the Maha season and for the entire area for the Yala season[12] with rice output (unhusked bushels) as the dependent variable and areas cultivated (acres), pre-harvest labour (man days) and the quantity of nitrogen applied (kg) as independent variables (Table 1).[13] Frequency distributions of individual technical efficiency estimates for the head and the tail are given in Table 2.

TABLE 1

Maximum Likelihood Estimates of Cobb–Douglas Stochastic Frontier Production Functions for Crop Year 1984/85[a]

	Maha		Yala
	Head reach $n=63$	Tail reach $n=61$	$n=87$
Variable	Coefficient	Coefficient	Coefficient
Intercept	+2·530***	+3·075***	+2·620***
	(0·3116)	(0·3318)	(0·5061)
Land	+0·624***	+0·760***	+0·252***
	(0·1176)	(0·1863)	(0·1315)
Pre-harvest labour	+0·408***	+0·145*	+0·489***
	(0·0888)	(0·1074)	(0·0806)
Nitrogen	+0·120***	+0·262***	0·083
	(0·0391)	(0·0677)	(0·0806)
σ^2	0·1183	0·6732	0·6419
γ	0·3575	0·9753***	0·9283***
	(0·3228)	(0·0200)	(0·0021)
Log likelihood function	−0·0115	−25·0235	−40·5824

Source: Ekanayake (1987*b*).

[a]Figures in parentheses are standard errors of estimates. ***Significant at the 1 per cent level; **significant at the 5 per cent level; *significant at the 10 per cent level.

Estimates of Technical Efficiencies

In the Maha season, the head gets plenty of water and the differences in micro-environments across land parcels are greatly reduced through irrigation. Hence, the relevant land-specific physical differences are minor. Further, the technology itself was developed for a well-irrigated environment and there is little need to fine tune it for this particular environment. The results (Table 1) are consistent with our *a priori* expectations. These results show considerable differences in responses

[11] Despite the well-known limitations, Cobb–Douglas specification was used, since the focus of this study is on efficiency measurement and not on the analysis of the underlying production technology. For a discussion of this point, see Taylor, Drummond and Gomes (1986).

[12] There is no head and tail distinction in the Yala season.

[13] In other specifications, inputs such as pesticides, weed-killers, potassium and phosphorus were also included (both in physical and value terms) as independent variables but were found not to be significant.

TABLE 2

Frequency Distributions of Farm-Specific Technical Efficiency[a]

Range	Maha/tail		Yala	
0–10	1	(1·63)	1	(1·14)
11–20	3	(4·91)	3	(3·44)
21–30	2	(3·27)	15	(17·24)
31–40	10	(16·39)	30	(34·48)
41–50	21	(34·42)	9	(10·34)
51–60	8	(13·11)	11	(12·64)
61–70	8	(13·11)	7	(8·04)
71–80	2	(3·27)	4	(4·59)
81–90	4	(6·55)	6	(6·89)
91–100	2	(3·27)	1	(1·14)
No. of cases	61		87	

Source: Ekanayake (1987*b*).

[a]Figures in parentheses are percentages.

of inputs between locations and seasons. While differences in water availability are probably the major explanatory factor, without location-specific agronomic research it is difficult to draw any firm conclusions. The value of γ is statistically significant. Hence, we cannot infer that deviations from the frontier in the Maha season in the head are due to technical inefficiency.[14]

However, conditions are quite different in the tail even in the Maha season. Often, water is received by tail farmers much later than head farmers and the water supply is erratic throughout the season. Such problems in irrigation systems have been well documented (for example, Moore, Abeyratne, Amarakone and Farrington 1983; Skold, Shinnawi and Nasr 1984; Goodell 1984). In the Yala season, there are such irrigation deficiencies throughout the cultivated area. Farmers need to exercise considerable skill in their management decisions regarding the timing and methods of various agronomic practices; those capable of adapting the available technology to their particular conditions will obtain higher output.

The high level of technical efficiency in the tail in the Maha season as well as for the entire cultivated area in the Yala season is indicated by high and statistically significant γ (Table 1).

Technical Efficiency, General Experience and Specific Experience

Formal education is one component of general training which permits an individual to seek, decode and analyse information. Secondly, experience in agriculture, broadly defined, can be treated as another component of general experience. Age is likely to be a good proxy for such general farming experience in a farming community.

Specific experience, on the other hand, may be land-specific (Rosenzweig and Wolpin 1985), as well as environment-specific.

[14] This does not imply that potential for improved productivity is entirely absent. The frontier itself can shift further outwards as farmers gain more proficiency in the use of some of the other inputs which at present are used equally inefficiently by all farmers.

Environment-specific experience may be defined in many ways. For example, Purana settlers in our sample have previous farming experience in the climatic conditions of the project area which can provide skills particularly relevant to those climatic conditions. On the other hand, farmers from the wet zone have experience in rice cultivation under conditions of relative water abundance (including irrigation). The 'other' farmers lack all of these experiences. Therefore, we specified farmer age, education, settler type and land-specific experience as determinants of technical efficiency.

The measure of technical efficiency (TE) is bounded between 0 and 1 and is not normally distributed. To overcome the problems caused by this when using regression techniques a new variable T is created by transforming TE where $T = \ln[TE/(1-TE)]$. This varies between $-\infty$ and ∞. This was regressed against the hypothesised determinants of technical efficiency.[15]

Results

On the basis of the earlier discussion, the following explanatory variables were included in the regression analysis for the Maha season tail: settler type, literacy, age and possession of land-specific experience in addition to particular management practices. In the Yala season regression, an additional dummy variable was included to distinguish the group of farmers who were leasing back their land.[16] The three settler types were distinguished with dummy variables for wet zone and

TABLE 3

OLS Estimates of Determinants of Technical Efficiency Variation in Maha/Tail Environment[a]

Variable	Coefficient	
Intercept	−0·2304	(0·3128)
Wet zone farmers[b]	+0·9270***	(0·2160)
Literacy[b]	+0·7171***	(0·1897)
Part-time farmers[b]	−0·4656**	(0·2245)
Farmers with land-specific experience[b]	+0·4954**	(0·2476)
Farmers receiving bank loans[b]	+0·7314**	(0·3369)
Heavily indebted farmers[b]	−0·4710	(0·3823)
Early-established long-aged varieties[b]	+0·7671	(0·6383)
Early-established short-aged varieties[b]	+0·4315***	(0·1640)
High pest damage[b]	−0·8583***	(0·1800)
High weed damage[b]	−0·3495*	(0·1919)
Manual weeding[b]	−0·4068**	(0·1716)
$\bar{R}^2 =$	0·60	
$F =$	9·2395***	

Source: Ekanayake (1987*b*).

[a]Figures in parentheses are standard errors of estimates. ***Significant at the 1 per cent level; **significant at the 5 per cent level; *significant at the 10 per cent level.
[b]Dummy variable.

[15] There is considerable controversy over whether this procedure is acceptable on theoretical grounds (see Hall and Bardsley 1987; Dawson and Lingard 1987). We feel that it is superior to alternative approaches in practical applications (see Dawson and Lingard 1987).

[16] While sale or even leasing was illegal, some recent leasing was observed.

TABLE 4

OLS Estimates of Determinants of Technical Efficiency Variation in Yala/Rice Environment[a]

Variable	Coefficient	
Intercept	1·2795***	(0·4879)
Purana farmers[b]	+0·5172***	(0·2121)
Farmer age	−0·0136*	(0·0078)
Farmers with land-specific experience[b]	+0·5172***	(0·2121)
Leasers[b]	+0·6491*	(0·3904)
Farmers receiving bank loans[b]	−1·1569*	(0·6495)
Water shortage	−0·2713**	(0·1340)
Long-aged varieties[b]	0·8434**	(0·4001)
Short-aged varieties[b]	−0·3495*	(0·2055)
$\bar{R}^2 =$	0·20	
$F =$	3·7258***	

Source: Ekanayake (1987*b*).

[a]Figures in parentheses are standard errors of estimates. ***Significant at the 1 per cent level; **significant at the 5 per cent level; *significant at the 10 per cent level.
[b]Dummy variable.

Purana farmers. Literacy, also included as a dummy variable, representing a minimum of 3 years of formal school, was based on the proposition that in small farm agriculture in LDCs a threshold of a minimum level of formal education providing literacy is more relevant than the number of years of formal schooling (Jamison and Lau 1982; Lipton 1985). Farmers with land-specific experience included all those who had been farming the particular parcel of land for 5 years or more. A potential problem was the existence of multicolinearity, particularly due to close relationships between farmers' practices and their attributes. However, none of the correlation coefficients between independent variables exceeded 0·30. The final regression models estimated using OLS are given in Tables 3 and 4.

Land-specific experience was significant and positive in both seasons. The coefficient of age was statistically insignificant in the Maha season (and the model was re-estimated without age) but was significant and negative in the Yala season. Experience in the wet zone (that is, wet zone farmer) was positive and significant in the Maha season. On the other hand, experience in the settlement area prior to irrigation (that is, being a Purana farmer) was positive and statistically significant in the Yala season.

Discussion and Conclusions

In this study, we have examined the adjustment of a group of farmers with diverse backgrounds and experiences who have been relocated in a significantly different new farming environment requiring the understanding and application of a set of new farming practices and technology. The level of relative technical efficiency demonstrated in these conditions was considered a measure of successful adjustment.

We postulated that different types of experience and skills are likely to have different influences on a farmer's ability to respond to the new circumstances. The roles of general farming experience (proxied by age), formal education (literacy), and environment-specific and land-specific experience were examined in this context. In particular, land-specific experience was clearly distinguished from other types of experience unlike in the Rosenzweig and Wolpin (1985) study. Regression models were formulated which enabled the importance of land-specific experience to be tested directly.

The results demonstrate that even in modernising agriculture land-specific experience is an important factor affecting efficiency in environments where physical differences between land parcels are likely to be substantial. In the regression models, it had a positive and significant effect in the Yala season; in the Maha season, while it was still positive, it was statistically less significant. As significant efficiency differences were not observed in the head in the Maha season, the relative importance of land-specific experience could not be estimated. However, such conditions of abundant water throughout the season resulting in homogeneous conditions across all land parcels would be found only rarely even in major irrigation schemes in LDCs. In many ways, the Yala season conditions are more typical of large areas of farm lands in developing countries. Hence, the results suggest that, despite expansion of irrigation facilities, land-specific experience is likely to remain important in much of LDC agriculture in the foreseeable future.

On the other hand, the distinction between land-specific experience and other types of experience clearly illustrated the different effects of various types of experiences on the ability to adjust to changing situations. The conditions in the Yala season placed heavy demands on farmers to respond in flexible and innovative ways to conditions that they had not experienced before. In this situation, location-specific experience was helpful. Hence, the Purana farmers performed better in the Yala season, drawing on their knowledge of farming in a situation of limited irrigation.

Wet zone farmers did better in the tail in the Maha season, helped by their experience in a somewhat similar environment. Further, the recommended technology package for high-yielding varieties of rice was better suited to the latter situation than the Yala season. Literacy, which facilitated knowledge of these recommendations, had a significantly positive effect in those conditions.

However, age, *per se*, actually hindered adjustment in the demanding Yala season conditions. While land-specific experience had a clear positive effect, age had a significant negative effect. Past experience, which was now made obsolete by the new environment and modern farming technology, appears to have been a burden; its legacy was 'conservatism' which hampered adjustment.[17] However, note that not *all* accumulated experience became obsolete with technological change since land-specific experience continued to be valuable.

What do these results mean for the future evolution of farming societies? The fact that land-specific experience is significant and likely

[17] Our results also raise the issue of equity versus efficiency in relation to settler selection and land sharing during the Yala season. Settlers with no relevant experience and those lacking literacy impose efficiency losses as does the granting of cultivation rights in the head to farmers from the tail during the Yala season. In the latter case, legalisation of lease back arrangements could help reduce such losses. In general, however, some trade off between equity and efficiency is perhaps unavoidable.

to remain so even in modernising agriculture suggests that good economic reasons exist for the continuation of the prevalent inter-generational family contracts. The spread of education, which can substitute for land-specific experience and whose role will probably be increasingly important, can lead to situations where the advantage of such contracts can decline. However, the extent of such a decline would depend on the pattern of diffusion of literacy across the population. If universal primary education does become a reality, farm family members may continue to be the highest bidders for family land since they would have the extra advantage of land-specific experience. Hence, inter-generational contracts of the type discussed by Rosenzweig and Wolpin (1985) need not disappear rapidly.

Indeed, the persistence of small family farms even in modern developed societies (with the associated phenomenon of the 'over-use' of family labour) may be due, at least partly, to this factor. Further study of the importance and implications of the role of specific experience may have considerable benefits for many areas of agricultural policy including land reform, land consolidation and land settlement schemes.

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