

# Farm Size, Productivity and Earnings

Dr Sarthi Acharya, CDRI's Research Director and Chan Sopha a CDRI researcher, present a paper which assesses the productivity and income of farms based on a range of different farm sizes. \*

Crop productivity in Cambodia is presently among the lowest in the Southeast Asian region. Rice yields here have always been low — for example, when in the 1960–70s, Taiwan, Korea, the Philippines and Indonesia were achieving productivity levels in excess of 3–3.5 tonnes per hectare — Cambodia never exceeded two tonnes. Multiple cropping has not yet caught up either as controlled irrigation is still limited to less than 10 percent of the cropped area.<sup>1</sup> In this regard, Cambodian agriculture could be categorised as low input agriculture, largely dependent on the bounties of nature.

Factors of low productivity, rising population, land atomisation, and high seasonal fluctuations, either individually or in combination, affect food security. In this respect, modernisation of agriculture and scientific land reforms are paramount. The first step in this direction is to understand the nature of technical and economic patterns in Cambodian agriculture; its productivity, incomes, costs, and similar factors. This article, attempts to contribute a better understanding of these issues using data drawn from a survey of 1,000 rural households, undertaken by CDRI over two phases in 2001. This paper particularly aims to answer the following questions:

- What is the nature of the relationship between farm size and productivity?
- What is the relationship between productivity, profitability and farmers' incomes?

## Farm Size and Productivity

The debate on farm size and productivity dominated literature on land reforms and land economics in Asia over several decades in the latter part of the 20<sup>th</sup> Century. The general proposition was that small farms, under the present endowments and means available to farmers, were more efficient than larger ones (reaping a higher yield per hectare). If lands were more equitably distributed, in smaller sizes, productivity would rise as would employment and food security.

The logic for smaller farmers being more productive in Asia is as follows:<sup>2</sup>

1. Given the spectrum of choices (in fact there are few

modern methods that would help reap economies of scale) small farmers use better techniques and exercise superior managerial control;

2. Although land tenancy impedes productivity, since small farms have relatively low incentive to rent out land, their yield rates are higher;
3. Family labour and other family-owned inputs are applied more intensively in small farms, irrespective of the level of marginal productivity, thereby raising yield rates;
4. The crop pattern and intensity chosen by small farmers is of higher value; and
5. Small plots are usually sub-divisions of highly fertile lands and it has been possible to fragment them economically in the course of inter-generational land transfers.

So far, not much is known about the applicability of these propositions for Cambodian agriculture, except that not all of them apply in all locales at all times. It has been found in field studies that many smaller plots are *hired out*. This is either because they yield insufficient incomes, or smaller farmers do not necessarily have the means for cultivation. Hiring out is also facilitated by the fact that the cropping pattern does not change very much in Cambodia: rice is grown in almost all seasons.<sup>3</sup>

Table 1 draws an empirical relationship between farm size and productivity and includes data for both wet and dry seasons crops. Farms have been grouped according to their size range (statistical distribution).

For the wet season crop, in which the input application is generally low, productivity measured as the rice-yield (tonnes per hectare, Table 1) is the highest in the smallest farms at 1.82 tonnes per hectare. There is a gradual fall in the yield rate as the farm size increases. The classical thesis suggested for Asia — that smaller farms are more productive — holds for Cambodia, as seen from the wet-season crop. This result is expected since the majority of Cambodian farmers still use traditional, subsistence-oriented cultivation methods. Another reason is that better quality lands are split into smaller plots, as revealed by data on land prices: smaller plots are priced higher than larger ones when measured on the basis of unit area.

The dry-season crop (Table 1) shows results that deviate from those for the wet season. The largest farms

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**Table 1: Productivity by Farm Size, Rice Cultivation, 2001**

Productivity	Farm Size Groupings (ha)				All
	>0-0.5	>0.5-1	>1-2	>2	
<b>Wet season crop</b>					
Sample farms	225	133	225	64	495
Mean area (ha)	0.34	0.84	1.69	3.99	1.15
Production (tonnes)	0.56	1.10	1.84	2.71	1.17
Yield (tonnes/ha)	1.82	1.29	1.08	0.75	1.43
<b>Dry season crop</b>					
Sample farms	95	70	68	44	277
Mean area (ha)	0.33	0.83	1.61	3.40	1.26
Production (tonnes)	0.81	2.16	4.30	9.17	3.33
Yield (tonnes/ha)	2.62	2.65	2.65	2.69	2.65

\* The article is derived from a CDRI study of nine villages and is the result of a full report on Land and Food Security, prepared by CDRI with financial assistance from DFID.

have the highest yield, though the difference between the large and small farms is not very high. Perhaps the inverse relationship between farm-size and productivity is disturbed because the dry crop is usually grown under controlled irrigation conditions, and farmers practise more modern methods of cultivation and crop husbandry. These arguments are supported by the fact that absolute yield rates are also generally higher in the dry season than the wet season.

Table 1 also indicates that total rice production (hence availability) with the smaller landholders is much lower despite higher productivity, at least in the wet season crop. This indicates that being efficient does not necessarily guarantee freedom from hunger. In this respect, seen in the context of food security, small farms are not always the most desirable. Instead, it is important to identify *how small, small farms should be* to ensure food security. This is an important lesson for land reforms.

In summary, it appears as if the farm size-productivity relationship holds with conditions of farming using traditional methods — wet season farming in this case. It tends to either break down or weaken when modern methods of farming are introduced — as with dry season farming. Next, considerations of food security impel one to look beyond productivity alone.

### Profitability of Crops

If an agricultural economy is integrating into the market system, as with Cambodia, profits and profitability are very meaningful propositions from the point of view of a *farmer*. In this case profit is defined as the amount left after cost deductions, meaning all material costs and hired labour costs. Capital costs or land costs in these settings are impossible to evaluate. Thus, profit is the return on land, capital and personal labour.

Table 2 provides data on profitability, defined as profit per household, profit per hectare, profit per tonne of rice, and profit per riel of production for both wet and dry season rice crops.

The last two rows for the wet season crop present the most perfect forms of profitability, namely profit as a proportion of production.<sup>4</sup> The profitability for the wet season crop (given as a percentage) is quite large in farms of all sizes: it is the highest in the farms of 0.5–1 hectare size, followed by the smallest farms in the 0–0.5 hectare range. Only in the largest farm size (> 2 ha) is profitability half the average. A similar pattern is seen for the '000 riels/tonne category for the wet season crop. While the general thesis of smaller farms — which yield more and are more profitable — is not being challenged, a point of caution must be raised. Smaller plot holders do not necessarily pay-out for all inputs: they provide significant input from their own resources, principally labour; and this does not get counted as a paid-out cost. This could partly be a reason for the smaller farms appearing more profitable.

Profitability is shown as the net income in riels per hectare, for both wet and dry season rice crops. If the economies of scale are neutral, then profitability per

hectare and profitability per unit output would show a perfect correspondence. Since this cannot be ascertained, this data has been presented separately ('000 riels/ha for both wet and dry season crops).

Again for the wet season crop, the smaller plots yield a higher income *per hectare*. However, *incomes* derived from the farming of smaller plots ('000 riels/household for the wet season crop) are distinctly lower than incomes derived from farming larger plots. The earlier conclusion, that under rain-fed conditions smaller farms are technically more efficient, is still echoed here in the form of their yielding higher *per hectare* incomes. However as indicated earlier, households owning smaller plots possess less food and earn lower *disposable* incomes.

Profitability ratios for the dry-season rice crop suggest a considerable drift from the classical 'farm size-productivity' and 'farm size-profitability' relationships. The profitability percentage (percentage of production for the dry season crop) is the highest for the *largest sized* farms. The 0.5–1 hectare group and then the 1–2 hectare group follow. While these numbers are not very different from each other, the profitability in the smallest group of farms, i.e. <0.5 hectare, is distinctly low: about half as much as that in the other size groups. The pattern is similar for profitability per tonne of paddy ('000 riels/tonne for the dry season crop) though a slight difference in the order has crept in because prices are not uniform across farms and villages.<sup>5</sup>

Profitability per hectare ('000 riels/ha for the dry season crop) is also higher in the larger farms than in the smaller ones. The positive association between profitability with farm size is not exact, but the general pattern holds. Dry season cultivation, therefore, negates the superiority of smaller farms. Generally data presented in Table 2 (especially '000 riels/household for the dry season crop) substantiate the earlier findings that households owning larger farms earn more in the dry season.

All this data supports the view that while under low-input farming conditions, small farms may be more productive and yield higher output per hectare; land fragmentation is harmful to the incomes and food security of farmers. Next, as low input farming gives way to more

Table 2: Profitability by Farm Size, Rice Cultivation, 2001

Profitability	Farm Size Groupings (ha)				
	>0-0.5	>0.5-1	>1-2	>2	All
<i>Wet season crop</i>					
Sample farms	225	133	73	64	495
'000 riels/household	129	264	341	371	227
'000 riels/ha	395	322	209	101	309
'000 riels/tonne	214	231	177	95	197
Percentage of production	68	71	58	31	63
<i>Dry season crop</i>					
Sample farms	95	70	68	44	277
'000 riels/household	107	325	589	1355	469
'000 riels/ha	179	393	362	293	305
'000 riels/tonne	93	147	134	141	122
Percentage of production	29	51	49	52	43

intensive use of fertilisers, controlled irrigation and modern variety seeds, even the yield advantage of the small farms is lost.

### Productivity and Profitability Associations

Should high crop yield rates be accompanied by high profitability, implying more income to farmers? Under normal conditions this relationship should be strong and positive unless market prices drastically change against primary products, or farms operate in zones where there are high diseconomies. Elasticity values were calculated to examine some finer points of this proposition.

The elasticity values represented as rows 1 and 2 in Table 3, suggest that a 10 percent increase in land yield, (profit/household) would increase to only 4.4 percent for wet-season cultivation and 8.8 percent for dry season cultivation. An increase in productivity — particularly in the wet season crop — would thereby increase the farmers household income much less than in proportion to the yield rate. The fact that incomes *per household* rise at a much slower rate than incomes *per hectare* with growth in land productivity, suggests that a change in yield rates is associated with some reorganisation of land ownership — there is most likely land fragmentation;<sup>6</sup> It is apparent that this is why increased yield rates do not provide commensurate incomes to farmers.

Elasticity values of profit per hectare with the yield rates (Rows 3 and 4, Table 3) show values close to one in both the wet and dry season crops implying that incomes per hectare expand in proportion to yield rates.

Finally, the elasticity of income derived *per tonne* of rice with the yield rate produces no significant relationship for the wet-crop, but for the dry crop, there is an 11 percent increase in the profit per tonne with a 10 percent increase in the yield rate. It is suggested that if the dry crop yield increases, the unit cost would decrease, thereby raising the competitiveness of the crop; a relationship that does not hold for the wet crop.

### Summary

This article examines the relationships between farm size, productivity and profitability. It is concluded that smaller farm sizes are generally, though not exclusively, more productive in terms of yield rates. They yield more in the wet season in the case of rice cultivation, but in

the dry season this relationship weakens. Since wet season rice cultivation requires little other than labour, and labour is in abundance in many of the villages, there is more intense application of human resources producing higher yields. In contrast, dry season crops are more carefully nurtured with applications of multiple inputs, and small plot holders are not necessarily in possession of, or capable of applying these inputs. With these factors taken into account the small plot size-productivity relationship weakens.

Small farms offer better incomes *per hectare*, particularly in the wet season, but do not yield better incomes to households. In the dry season, even this relationship weakens. While land productivity and profit per hectare are closely synchronised, the elasticity of household income to the land yield rate is less than one. Land fragmentation is the reason for this with better quality lands simply being fragmented faster.

The results presented in this article indicate the negative consequences of excessive land fragmentation. The article also outlines the virtues — or lack of virtues — inherent with small farms. Cambodia, like many other parts of Southeast Asia, is a traditional small farm oriented economy. However, with changing technologies and agricultural market integration, the traditional wisdom and traditional models may no longer be sustainable.

***Cambodia is a traditional small farm oriented economy. However, with changing technologies and agricultural market integration, the traditional wisdom and traditional models may no longer be sustainable.***

### Endnotes

1. The figure on controlled irrigation has been obtained from the Ministry of Agriculture, Forestry and Fisheries.
2. These results have been derived from data sets pertaining to East, Southeast and South Asia. A succinct discussion on farm size and productivity can be seen in Acharya (1995).
3. See for instance, Kim, Chan and Acharya (2002).
4. This measure is so referred because it reflects the technical capacity of an enterprise or a farm.
5. There are two obvious reasons why prices are different: First, different farmers sell their crops at different times, secondly there are regional variations.
6. Field inquiries suggest that better quality land is fragmented faster, which is in line with the proposition that 'Small plots are usually subdivisions of highly fertile lands'.

### References

- Acharya, S. (1995) *Some Aspects of Indian Agriculture*, Monograph No. 108, The Hague: Institute of Social Studies.
- Kim, S. Chan, C. and Acharya, S. (2002) *Land, Rural Livelihoods and Food Security in Cambodia: A Perspective from Field Reconnaissance* Working Paper No. 24, Phnom Penh: Cambodia Development Resource Institute (forthcoming).

**Table 3: Elasticity Values of Profitability with Yield Rates**

Wet crop: with profit/household	0.44
Dry crop: with profit/household	0.88
Wet crop: with profit/ha	1.01
Dry crop: with profit/ha	0.94
Wet crop: with profit/production	0.14
Dry crop: with profit/production	1.10