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Agriculture, GDP and Prospects of MDG 1 in Lao PDR

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Objectives

The objective of this study is to assess the prospects of Lao PDR shedding its status as the poorest country in South East Asia and achieving the MDG goal of halving dollar poverty by half (over the 1990's incidence) by 2015. The focus is on accelerated agricultural growth and associated with it GDP growth acceleration, and their implications for achieving MDG1. Policy influences through public investment in agriculture, FDI and trade liberalisation in the intensification and diversification of agriculture will be examined. As value of crops produced remains a significant share of agriculture, growth and variability of major crop yields spatially and over time will be examined. With the availability of Lao Expenditure and Consumption Survey 4 (LECSIV), an attempt will be made to analyse inter-village variation in three different measures of poverty (using the official poverty line, the food poverty line and the $1.25 poverty line). As geography (altitude and remoteness limit market access) and ethnicity are associated with variation in poverty, their roles will be assessed. From a different perspective (and for methodological reasons), poverty variations associated with village level expenditure and inequality in its distribution will be analysed to be able to point to the importance of not just growth but more equitable growth. Finally, an attempt will be made to analyse how poverty prone smallholders are.

Issues

Key issues therefore in the context of the 7th Five Year Plan are as follows:

1. Although agriculture has maintained a steady growth of over 4.16 per cent annually, an issue is prospects of accelerating it through greater intensification (mechanisation, irrigation, fertiliser and seeds).
2. As value of crops remains a major share of agriculture and crop yields continue to remain low, spatial and temporal patterns of yield growth and variability are of interest- in particular, whether higher crop yields are associated with greater variability and whether there are diverse regional patterns. A related issue is whether intensification (mainly through irrigation) would help raise yields of different crops significantly.

3. Another issue is diversification of agriculture. Disaggregating agricultural value added into values of crops produced, forestry products, and livestock and fisheries, a policy concern is the different roles of enhanced public investment, FDI and trade liberalisation over time.
4. Following from this analysis is the issue of what plausible assumptions on higher public investment in agriculture, FDI and trade liberalisation imply in terms of agricultural growth. More specifically, what levels of these variables are consistent with the observed trend rate of agricultural growth and its acceleration?
5. What rates of GDP growth are consistent with a feasible range of agricultural growth, taking into account the long-term effect of the latter on the former?
6. Given the profile of rural poverty in Lao PDR-rural poverty accounts for about 83 per cent of total poverty, and its spatial and ethnic dimensions-an important issue is to assess their contributions in explaining inter-village variations in different poverty indices. Another perspective is to analyse the variations due to higher living standards and inequality in expenditure distribution. Thus new light may be thrown on the potential of growth and equitable distribution in reducing rural poverty.
7. Building on this analysis, we explore the consistency of feasible agricultural and GDP growth rates with MDG1. As we have just four comparable national poverty estimates on $1.25 per day over the period 1992/93 -2007/8, the elasticities of poverty with respect to GDP and agricultural growth are a first approximation.[1].

These issues are addressed below, drawing upon FAOSTAT, WDI 2010, *Handbook of Statistics* (LOG, 2009a), *Agricultural Statistics* (LAO, 2009b), and *Lao Expenditure and Consumption Survey IV* (LECS IV)[2].

[1] For a detailed analysis with cross-country data (including Lao PDR), see Imai et al. (2010)-a study sponsored by PI, IFAD.
[2] We are grateful to the Ministry of Agriculture and Department of Statistics for the courtesy of arranging access to their data sets.

Intensification

Let us first consider an aggregate production function for agriculture over the period 1985-2001. The specification used is double log, as given below. Given the paucity of time series data-especially on fertiliser-we have relied on the double log form (akin to the Cobb-Douglas production function)[3].

$$\log y_t = \alpha + \beta_1 \log \text{Machinery}_{t-1} + \beta_2 \log \text{Irrigation}_{t-1} + \beta_3 \log \text{Fertiliser}_{t-1}$$

$$+\beta_4 \log \text{Seeds}_{t-1} + \lambda_1 + \lambda_2 + \lambda_3 + \lambda_4 + \varepsilon_t \text{..................(1)}$$

where

y –agricultural value added,

Machinery-use of tractors and other mechanical implements,

Fertiliser-total fertiliser used,

t-year,

λ_1-a dummy for years 1986-89 (a period of early reforms),

λ_2-a dummy for 1994 (successful economic management and stabilisation),

λ_3- a dummy for years 1997-98 (Asian financial crisis),

λ_4-a dummy for years 2000-04 (a period of recovery and restabilisation)[4], and

ε-iid error term.

Note that, to circumvent the endogeneity of right side variables (i.e. inputs into agricultural production), their lagged values are used (as the lagged value of a variable is its own instrument).

Three sets of results are given in Table 1 and the lower panel contains simulations based on the elasticities computed from the regression results. These results are based on OLS, robust regression and Cochrane-Orcutt procedures (to correct for serial correlation).

The key findings are:

- Each of the four inputs (mechanisation, irrigation, fertiliser and seeds) has a significant effect on agricultural value added.
- Only one dummy (i.e for the period of the Asian financial crisis) has a significant positive effect. This is somewhat surprising but there is evidence of agriculture's stabilising effect on income volatility in a sample of Asian countries (Gaiha and Thapa, 2006).

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[3] With a longer time-series, it would be worthwhile to experiment with more flexible production functions.

[4] For elaboration of these phases of policy reforms, crises and reconstruction, see LOG (2010 a) and World Bank (2009).

- The overall specification is validated by the F-test. However, the D-W statistics is in the inconclusive range. Accordingly, the Cochran-Orcutt procedure was employed. A graphical illustration of the predictive accuracy is given in Fig: 1.
- The elasticities (or coefficients of the robust and Cochran-Orcutt regressions) allow us to assess the relative importance of different inputs in agricultural growth. Agricultural output elasticities with respect to mechanisation is largest (1.12 per cent), followed by seeds (0.23 per cent), irrigation (.12 per cent) and fertiliser (about 0.03 per cent)[5]. The (relatively) small elasticity of agricultural value added to irrigation is largely a reflection of poor maintenance of irrigation systems while that of fertiliser is due to extremely low applications[6].The simulations show the effects of intensification through 1 and 5 per cent higher values of each of the four inputs on agricultural value added. If each input increases by 1 per cent-a modest increase- agricultural value added will be larger by nearly 1.50 per cent. So agricultural intensification could potentially make a substantial contribution to agricultural growth acceleration –in fact, our results show a more than proportionate increase in agricultural value added**.** As size distribution of cultivated land varies over a narrow range, most results on crop values are generalisable to smallholders (except that the potential contribution of mechanisation is likely to be lower for smallholders).

[5] Note that the fertiliser coefficient is weakly significant in the Cochrane-Orcutt regression.

[6] We are grateful to Dr Parisak for pointing out these reasons during a discussion at NAFRI. A recent ADB study (2010) confirms that operating and maintenance costs of irrigation schemes are a major fiscal burden. That the fertiliser use in Lao PDR is extremely low can be gauged from the fact that NPK input is 10-20 kg/ha compared with 70-80 kg in Vietnam and Thailand. Also, although new seed varieties have been developed by Lao IRRI, the majority of Lao farmers continue to use traditional seed varieties (LOG, 2010 a).

Table 1
Agricultural Production Estimates

	OLS	Robust	*Cochrane-Orcutt*
Explanatory Variables			
Agricultural Machinery (Tractors)[a]	1.1253	1.1253	1.3419
	(0.0928)**	(0.0956)**	(0.0000)**
Total Area Equipped for Irrigation[1b]	0.1207	0.1207	0.1394
	(0.0562)+	(0.0508)*	(0.0013)*
Total Fertilizer Consumption [c]	0.0262	0.0262	0.0088
	(0.0123)+	(0.0104)*	(0.1990)
Total Seeds [d]	0.2334	0.2334	0.2291
	(0.048)**	(0.047)**	(0.0001)**
Year Dummy for 1986 – 1989	0.032	0.032	-
	(0.0239)	(0.0233)	-
Year Dummy for 1994	0.011	0.011	-
	(0.0193)	(0.0144)	-
Year Dummy for 1997-1998	0.0271	0.0271	-
	(0.0134)+	(0.0112)*	-
Year Dummy for 2000-2004	0.0233	0.0233	-
	(0.0223)	(0.0067)*	-
Constant	9.0613	9.0613	7.6705
	(0.7528)**	(0.7914)**	(0.0000)**
Number of Observations	16	16	15
Adjusted R^2	0.995	0.998	0.994
Durbin-Watson Test	2.094	-	1.938
F-statistics	***451.41***		546.82**

1. FAOSTAT uses this variable as a measure of irrigation. a. measured in terms of number of tractors in use; b. measured in terms of area (1000HA); c. measured in tonnes consumed and d. measured in tonnes (aggregate).

SIMULATIONS

	Robust		*Cochrane-Orcutt*	
	1 PER CENT	*5 PER CENT*	*1 PER CENT*	*5 PER CENT*
Agricultural Machinery (Tractors)	1.1253	5.63%	1.3419	6.71%
Total Area Equipped for Irrigation	0.1207	0.60%	0.1394	0.70%
Total Fertilizer Consumption	0.0262	0.13%	0.0088	0.04%
Total Seeds	0.2334	1.17%	0.2291	1.15%

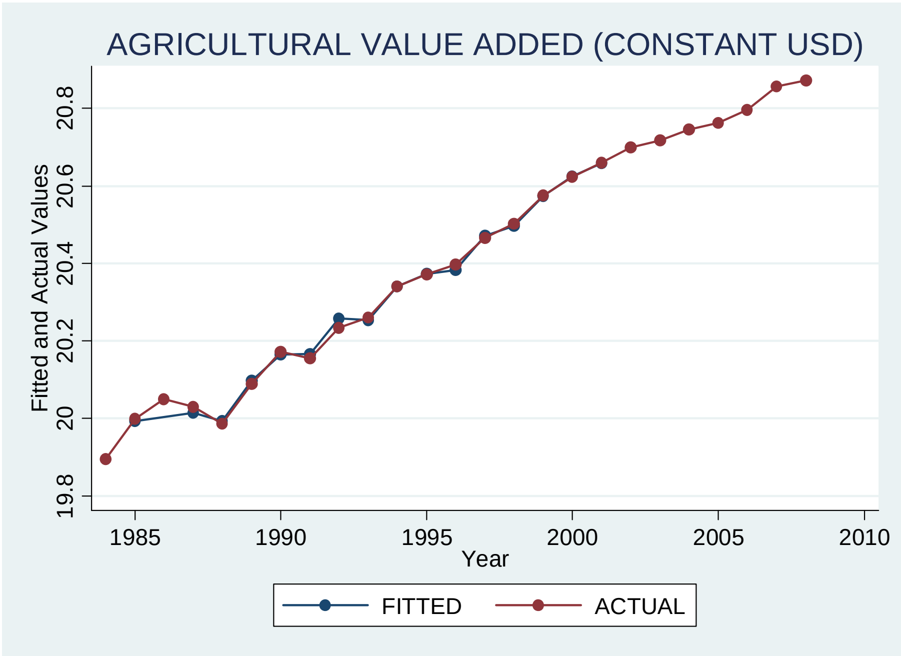


Fig: 1 Predictive Accuracy of Agricultural Production Function Estimated

Crop Yields-Growth and Variability

Although share of crops in agriculture has fluctuated-from 60 per cent in 2001, to 58 per cent in 2005 and 75 per cent in 2008 –it remains the largest component. So crop yields have an important role in determining agricultural value added, given crop prices. In this section, we will examine growth of crop yields, their determinants and variability, using province-level data obtained from *Laos Agricultural Statistics* for the period 2001-2008.

(a) Growth Rates of Crop Yields

To compute the annual growth rates of crop yields, the following specification was used:

$y_{cpt} = ab^{t}$ ....(3)

where the dependent variable is a physical measure of crop yield (of a particular crop) in year t. Given gaps in the time series of data in *Agricultural Statistics*, we could construct time-series on rice, maize, coffee, vegetables and all four crops.

First, the growth rates are computed at the national level and then for each of the three regions (Southern, Central and Northern). The regression results and annual growth rates (values of estimated b) are given in Table 2.

Table 2
Trends in Crop Yields

Commodities	Entire Data	Southern	Central	Northern
Rice	0.0232	0.0174	0.0105	0.0375
	(0.0057)**	(0.0080)*	(0.0076)	(0.0065)**
Maize	0.0798	0.0818	0.0694	0.0876
	(0.0094)**	(0.0181)**	(0.0139)**	(0.0143)**
Coffee	-0.0324	-0.0528	0.2907	-0.1620
	(0.0453)	(0.0209)*	(0.1813)	(0.1249)
Vegetables	0.0268	0.0515	0.0068	0.0413
	(0.0138)*	(0.0230)*	(0.0219)	(0.0232)+
All four crops	0.0427	0.0474	0.0244	0.0558
	(0.0075)**	(0.0124)**	(0.0129)+	(0.0112)**

Standard Errors in parenthesis ** Significant at one per cent; * Significant at five per cent & + Significant at ten per cent.

	Percentage Growth Rates			
	Entire Data	**Southern**	**Central**	**Northern**
Rice	2.32%	1.74%	1.05%	3.75%
Maize	7.98%	8.18%	6.94%	8.76%
Coffee	-3.24%	-5.28%	29.07%	-16.20%
Vegetables	2.68%	5.15%	0.68%	4.13%
All four Crops	4.27%	4.74%	2.44%	5.58%

The main findings are:

- At the national level, there are positive trends in yields of all crops except coffee. At the regional level, all crop yields show positive trends except coffee which has a significant negative trend. In the Central region, both maize and all four crops taken together show positive trends. In the Northern region, rice, maize, vegetables and all four crops (the combined measure) show significant positive trends. So there is a regional contrast in the growth of crop yields.
- At the national level, maize yields grew most rapidly (annual rate of about 8 per cent), followed by vegetables (about 2.7 per cent) and rice (about 2.3 per cent)[7]. The combined crop yield thus grew at a rate of about 4.3 per cent. In the Southern region, maize grew at an impressive rate (over 8 per cent annually)

[7] Note that our comments are confined to those cases in which there was a significant positive or negative trend.

while rice grew at a slow rate (about 1.75 per cent). By contrast, coffee recorded a more than moderate fall (over 5 per cent per annum)[8]. The combined yield of all 4 crops, however, grew at a slightly faster rate than the national rate (4.75 per cent as against about 4.3 per cent). In the Central region, maize grew at close to 7 per cent annually but the combined crop yield was just about 2.5 per cent-a little over half the national growth rate. The Northern region recorded highest yield growth rates for maize, vegetables and rice (in that order). As a result, the combined yield growth was also highest (and well above the national average).

(b) Determinants of Crop Yields

Using province-level data, we have analysed the determinants of crop yields. This throws further light on the significant role of irrigation in raising different crop yields. The specification estimated is given below:

$$y_{cpt} = \alpha + \beta_i \mathrm{HarvestedArea}_{cpt} + \beta_2 \mathrm{ShareIrrigatedArea}_{cpt}$$

$$+\lambda_{02} + \lambda_{03} + \lambda_{04} + \lambda_{05} + \lambda_{06} + \lambda_{07} + \lambda_{08} +$$

$$\delta_S + \delta_N + \varepsilon_{cpt} \text{..........(4)}$$

where

y_{cpt} -crop yield (c) in province (p) in year (t),

Harvested Area- harvested area (ha),

Share Irrigated Area-% share of harvested area irrigated,

λ_{02} -dummy for year 2002, and other year dummies for different years (2003, 2004, 2005, 2006, 2007 and 2008),

δ_S -regional dummy for the Southern region,

δ_N -regional dummy for the Northern region, and

ε_{cpt} -iid error term.

Note that a slightly different specification was employed for coffee, as shown below.

The crop-specific results are given in Table 3. The main findings are:

- Irrigated area has positive effects on yields of rice, maize, vegetables and all four crops combined.

[8] In recent years, more attention is being given to growing better quality coffee- a dimension that the data at our disposal did not allow us to investigate. On this, see ADB (2010) and LOG (2010 a).. This was also emphasised by Dr Parisak and Dr Somchit Intaminth during our presentations at NAFRI and Ministry of Planning and Investment.

- Harvested area has a positive effect on rice yields[9].
- The year dummies associated with policies and completion of reform phases have significant yield effects. The 2002 dummy has positive effects on rice, coffee, vegetables and all 4 crops combined. The dummy for 2004 has positive effects on rice, maize, vegetables and all four crops. Similar effects are obtained with the dummies for 2005 and 2006 except a negative effect on coffee with the latter. The 2007 dummy is associated with positive effects on rice, maize, vegetables and all crops. The 2008 dummy is associated with similar effects except a negative effect on coffee.
- The effects of regional dummies for the South and North (relative to the Central) vary. The Southern dummy is associated with lower maize, and all 4 crops' combined yields. The Northern, on the other hand, is associated with lower rice and coffee yields, and higher maize yields.
- In the case of coffee, a different specification was used. Apart from the regional and year dummies, dry season irrigation has a positive effect on coffee yields while interaction of irrigation with the Southern dummy has a negative effect that neutralises the positive effect[10].
- How large are the elasticities can be assessed from the results in Table 4. A 5 per cent increase in the share of irrigated area is associated with a 1 percent higher rice yield, 0.42 per cent higher maize yield, and a little over 1 per cent higher yield of vegetables. For all four crop yields taken together, the increase is about 0.81 per cent. The effect on coffee yield is, however, nil.
- This result is generalisable to smallholders to the extent irrigation makes a difference to crop yields on its own.

[9] Since planted/harvested area fluctuates a great deal, an increase does not necessarily imply poor soil quality and lower yields.

[10] Note that when an explanatory variable is interacted with another, the marginal effect of a change in one depends both on its own coefficient and the coefficient of the interaction term.

Table 3
Regression Analysis: Dependent Variable – Crop Yield
Determinants

	Crops				
Explanatory Variables	**Rice**	**Maize**	**Coffee**	**Vegetables**	**All four Crops**
Share of Total Irrigated Area	1.5775	0.7041	-	3.4476	5.4752
	(0.1731)**	(0.3656)+	-	(0.8674)**	(1.0263)**
Total Harvested Area	0.00	0.00	-	0.00	0.00
	(0.00)**	(0.00)	-	(0.00)	(0.00)
2002 Year Dummy	0.1382	0.1448	0.0845	1.9439	2.2474
	(0.0789)+	(0.1967)	(0.0275)**	(0.4453)**	(0.4927)**
2003 Year Dummy	0.0748	0.1231	-0.321	0.1955	0.5409
	(0.0914)	(0.2139)	(0.155)+	(0.2876)	(0.3475)
2004 Year Dummy	0.6158	0.5237	0.1747	2.0316	3.2218
	(0.0984)**	(0.2096)*	(0.236)	(0.3687)**	(0.4201)**
2005 Year Dummy	0.6637	1.6266	-0.3928	3.2492	5.6204
	(0.0850)**	(0.2018)**	(0.2487)	(0.3764)**	(0.4612)**
2006 Year Dummy	0.3238	1.0514	-0.1491	2.2927	3.6404
	(0.0880)**	(0.2160)**	(0.0796)+	(0.3734)**	(0.4703)**
2007 Year Dummy	0.4810	1.4774	-0.0526	3.5043	5.4469
	(0.0807)**	(0.2293)**	(0.0876)	(0.4913)**	(0.5566)**
2008 Year Dummy	0.6904	1.7749	-0.1390	0.9823	3.884
	(0.0845)**	(0.3305)**	(0.1943)	(0.7230)	(0.8696)**
Southern Region	0.0615	-0.3688	0.2468	0.7661	0.8466
	(0.0768)	(0.1701)*	(0.48i8)	(0.4105)+	(0.5111)
Northern Region	-0.1580	0.3812	-1.1075	0.2018	0.2154
	(0.0708)*	(0.1596)*	(0.4933)+	(0.4164)	(0.5244)
Irrigated Dry Season	-	-	0.0004	-	-
	-	-	(0.0002)*	-	-
Total Irrigated Area	-	-	0.00	-	-
	-	-	(0.00)	-	-
Irrigated Dry *Southern	-	-	-0.0004	-	-
	-	-	(0.0002)*	-	-
Constant	2.066	2.1968	0.5375	3.1626	7.8509
	(0.1312)	(0.3073)	(0.4916)	(0.6834)	(0.8424)
Number of Observations	136	136	49	136	136
Adjusted R^2	0.73	0.61	0.64	0.48	0.60
F-statistics	39.73**	28.21**	2.74**	18.17**	29.36**

Standard Errors in parenthesis ** Significant at one per cent; * Significant at five per cent & + Significant at ten per cent.

Table 4
Simulations for Crop Yields[1]

Crops	Changes	Share Irrigated Area	Share Dry Irrigated Area
Rice	5% (10%)	1.0%(1.99%)	
Maize	5% (10%)	0.42% (0.84%)	
Coffee	5% (10%)	-	0.0%
Vegetables	5% (10%)	1.02%(2.03%)	
Yield for all 4 Crops	5% (10%)	0.81%(1.61%)	

Figures in the second column denote increases in shares of irrigated and dry irrigated areas, respectively. The next two columns denote increases in crop yields.

(b) Variability of Crop Yields

In the preceding section, the focus was on growth of crop yields and the underlying factors-especially irrigation. Here the focus is on spatial distributions of crop yields over the period 2001-08, using province-level data. We examine the differences in the means and variances of crop yields across the three regions (Southern, Central and Northern), and over time. This is followed by decompositions of variances in crop yields into variance of production, area harvested /area irrigated, and their covariances[11].

Let us first examine the spatial distributions over the period 2001-08.

The mean yield of paddy/rice per ha of harvested area at the national level was about 3.17 tonnes and the standard deviation (hereafter SD) was 0.48. The highest regional yield was in the Central region (about 3.53 tonnes) while the lowest was in the Northern region (about 2.90 tonnes). The SD was highest in Central region too while the lowest was in the Northern region. As shown below in Figs: 2a and 2b, the distribution of rice yields was approximately normal (also corroborated by the skewness measure being close to 0 and the kurtosis being under 3).

The mean yield of maize at the national level was 3.33 tonnes and the SD was 0.95. It was highest in the Northern region (3.61 tonnes) and lowest in the Southern region (2.80 tonnes). The former also had the highest SD. As shown in Figs: 2a and 2b, the maize yield distribution at the national level follows closely the normal distribution (with the skewness and kurtosis measures being 0.47 and 2.77, respectively)[12].

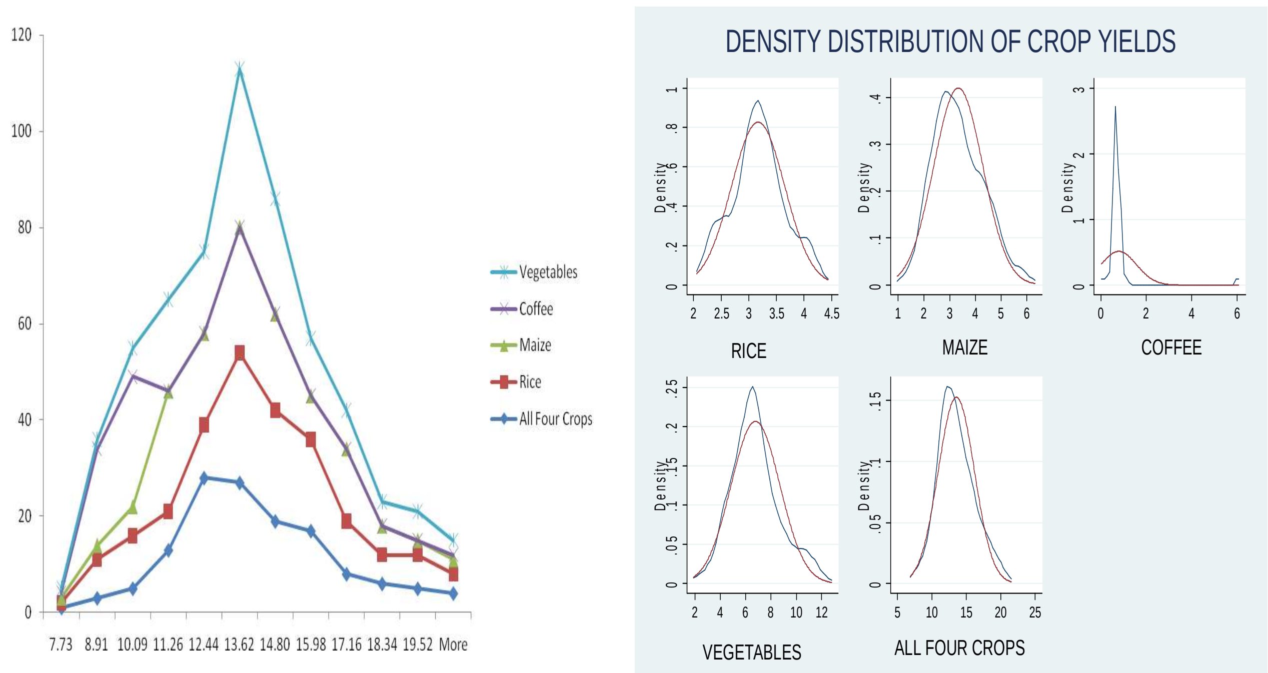
[11] These decompositions are essentially descriptive in so far as the factors underlying the right side variables are not unravelled.
[12] These curves are obtained using kernel densities.

The coffee yield at the national level was about 0.78 tonne with a standard deviation of 0.78.The Central mean was more than twice the national mean and the SD was nearly three times larger.

As illustrated in Figs: 2a and 2b, the departure from normality is pronounced (with the skewness and kurtosis measures being 6.27 and 42.57, respectively).

The vegetable yield is much higher than those of other crops but so also is the SD at the national level. At the regional level, the highest yield was in the Central region (7.18 tonnes) but the SD was highest too. The probability density function of the yields depart from the normal distribution as both the skewness and kurtosis measures- especially the latter- (0.52 and 6.59)-, are higher than those of the normal distribution.

For yields of all four crops taken together, the national mean was 13.57 tonnes while the SD was 2.62. The regional average was highest in the Central region (14.28 tonnes) as also the SD. As shown in Figs: 2a and 2b, the departure from normality is slight.



Figures 2a and 2b: Distribution of Crop Yields

Table 5
SUMMARY STATISTICS OF CROP YIELD ACROSS REGIONS

	Regions	Rice	Maize	Coffee	Vegetables	All Four Crops
	Southern					
Mean		3.0854	2.7998	0.6900	6.8529	13.4282
Standard Deviation		0.3335	0.8163	0.1463	1.9711	2.4794
Median		3.1304	2.5580	0.6875	6.2116	12.6856
Skewness		-0.5411	0.9105	-0.5615	0.9188	0.6384
Kurtosis		2.8007	3.8891	3.1072	2.8432	2.3707
Mean	*Central*	3.5384	3.3687	1.8528	7.1819	14.2821
Standard Deviation		0.4182	0.8778	2.3269	1.9409	2.7088
Median		3.4894	3.1507	0.7895	7.0266	13.8354
Skewness		-0.0538	0.7571	1.4731	0.1710	0.4254
Kurtosis		2.1097	3.2578	3.2121	2.9927	2.5130
Mean	*Northern*	2.9002	3.6127	0.6056	6.4107	13.0534
Standard Deviation		0.4034	0.9664	0.2026	1.8561	2.5201
Median		2.9757	3.5249	0.6154	6.4751	12.8873
Skewness		-0.1102	0.1128	-0.8675	0.5956	0.3113
Kurtosis		2.1805	2.5811	5.6004	4.0567	3.5337
Mean	*National*	3.1690	3.3353	0.7880	6.7870	13.5752
Standard Deviation		0.4826	0.9498	0.7793	1.9294	2.6171
Median		3.1620	3.1897	0.6667	6.5880	13.1331
Skewness		0.0760	0.4681	6.2695	0.5178	0.4442
Kurtosis		2.6737	2.7688	42.577	3.2379	2.9637

In Table 5, the crop yield distributions are given for three different years-2001, 2005 and 2008.

The mean rice yield rose between 2001 to 2005 - from 2.90 tonnes to 3.41 tonnes-while the standard deviation decreased - from 0.56 to 0.36. Over the more recent period, 2005-08, the mean remained unchanged but the SD rose slightly-from 0.36 to 0.40[13].

[13] For details of why low yields persist, see ADB (2010) and LOG (2010 a).

The maize yield rose over the period 2005-08-from 2.55 tonnes to 4.10 tonnes-while the SD fell-from 0.77 to 0.53. Over the period 2005-08, the yield rose slightly-from 4.10 to 4.21-while the SD more than doubled-from 0.53 to 1.17.

The mean yield of coffee fell over the period 2001-05-from 0.80 tonne to 0.62 tonne-while the SD rose-from nearly 0.0 to 0.07. Over the more recent period, the mean yield rose-from 0.62 tonne to 1.18 tonnes but with a marked rise in the SD-from 0.07 to 1.83.

The vegetables' yield rose more than moderately over the period 2001-05-from 5.26 tonnes to 8.15 tonnes-while the SD fell-from 1,44 to 1.29. Over the more recent period, the mean fell-from 8.15 tonnes to 5.77 tonnes but with a sharp rise in the SD-from 1.29 to 2.75.

The combined yield of all four crops rose over the period 2001-05-from 10.90 tonnes to about 16 tonnes but decreased slightly in 2008 (to 14 tonnes). The SD first fell-from 2.09 to 1.62, and then rose sharply (to 3.38).

In sum, a mixed pattern is revealed with higher yields in a few cases and rising variability over the period 2001-08.

Table 6
Summary Statistics for Crop Yield Over time

Years		Rice	Maize	Coffee	Vegetables	All four Crops
2001	**Number of Observations**	17	17	4	17	17
	Mean	2.9050	2.5535	0.8003	5.2606	10.9074
	Standard Deviation	0.5593	0.7688	0.0005	1.4394	2.0990
	Skewness	0.5286	0.9114	1.1547	0.5177	0.3918
	Kurtosis	2.6086	3.6618	2.3333	2.3956	2.4683
2005	**Number of Observations**	17	17	8	17	17
	Mean	3.4075	4.1053	0.6214	8.1546	15.9598
	Standard Deviation	0.3568	0.5320	0.0716	1.2943	1.6176
	Skewness	0.2135	-0.6116	-0.2923	0.4986	0.7591
	Kurtosis	2.3744	1.8366	2.1329	2.4531	2.8698
2008	**Number of Observations**	17	17	9	17	17
	Mean	3.3956	4.2060	1.1844	5.7735	14.0022
	Standard Deviation	0.3982	1.1650	1.8318	2.7527	3.3795
	Skewness	0.1924	0.0537	2.3428	1.0924	0.5497
	Kurtosis	3.3092	1.9294	6.7512	3.2431	2.4335
Total	**Number of Observations**	136	136	49	136	136
	Mean	3.1690	3.3353	0.7880	6.7870	13.5752
	Standard Deviation	0.4826	0.9498	0.7793	1.9294	2.6171
	Skewness	0.0760	0.4681	6.2695	0.5178	0.4442
	Kurtosis	2.6737	2.7688	42.5776	3.2379	2.9637

The decomposition of crop yield variability over time for the three regions is shown in Tables 7 and 8. We examine the variability arising from production and harvested/irrigated land area and their covariance. For expositional convenience, variances of log of yield, production and area are referred to as variances in yield production and area, as there is a monotonic relationship between logs and untransformed values. With the exception of coffee, yield variability is associated more with changes in production than harvested land area. Similar patterns are observed with irrigated land area. However, the production variance of rice accounts for a relatively small share of the yield variance.

Yields variability of all crops, with the exception of coffee for which enough data are not available, increases over the period 2001 and 2008.

Comparing the crops, the greater variability of maize over this period was much higher than that of vegetables and rice in that order. While production variability in maize and vegetables increased, that of rice declined. In spite of the greater production variability for vegetables, the covariance between production and irrigated land area declined. By contrast, between the period 2001 and 2008, the covariance of production and irrigated land area increased in the case of maize.

Analysing variability across the regions shows that the Northern region has greater variability in yields irrespective of the crop, followed by the Central and then the Southern region. Production variability, however, varies for different crops across the regions. Thus, for rice and vegetables, production variability in the Southern region is greater than that of the other regions, while, for maize, the Northern region exhibits greater production variability. In terms of the covariance between production and irrigated land area, the Southern region shows greater variability for all crops.

Table 7
Variance Decomposition of Crop Yields (Harvested Area)

	Rice				Maize			
	Var log (Yield)	**Var log (Prod)**	**Var log (Area)**	**2*[Cov log (Prod, Area)]**	**Var log (Yield)**	**Var log (Prod)**	**Var log (Area)**	**2*[Cov log (Prod, Area)]**
2001	-1.0200	0.7119	-0.5279	-1.2039	-1.6564	1.0193	-0.8713	-1.8044
2005	-1.0227	0.5912	-0.5168	-1.0971	-1.8410	1.0655	-0.9298	-1.9768
2008	-1.0633	0.6483	-0.5386	-1.1730	-3.5501	2.4121	-1.8184	-4.1438
Southern	-2.0928	1.2218	-1.0527	-2.2619	-1.2564	0.9398	-0.6673	-1.5290
Central	-0.6815	0.4204	-0.3480	-0.7539	-1.0214	0.7416	-0.5430	-1.2200
Northern	-0.2525	0.1421	-0.1364	-0.2582	-2.1760	1.4800	-1.1300	-2.5263

	Vegetables			
	Var log (Yield)	**Var log (Prod)**	**Var log (Area)**	**2*[Cov log (Prod, Area)]**
2001	-1.8168	1.2872	-0.9451	-2.1589
2005	-1.6380	1.0086	-0.8311	-1.8154
2008	-2.2289	1.6684	-1.2140	-2.6834
Southern	-2.6593	1.3395	-1.3660	-2.6329
Central	-0.5987	0.5385	-0.3428	-0.7944
Northern	-1.0938	0.7357	-0.5923	-1.2371

Number of Observations for years = 17 & Number of Observations for Region: Southern = 32; Central = 48 & Northern = 56. Coffee is not included due to non-availability of data.

Table 8

Variance Decomposition of Crop Yields (Irrigated Area)

	Rice				**Maize**			
	Var log (Yield)	**Var log (Prod)**	**Var log (Area)**	**2*[Cov log (Prod, Area)]**	**Var log (Yield)**	**Var log (Prod)**	**Var log (Area)**	**2*[Cov log (Prod, Area)]**
2001	-1.7707	0.7119	- 0.9326	- 1.5499	-0.5729	1.0193	- 0.9326	- 0.6597
2005	-1.7374	0.5912	- 1.0154	- 1.3132	-0.5891	1.0655	- 1.0154	- 0.3196
2008	-1.1426	0.6483	- 0.7088	- 1.0821	0.7788	2.4120	- 0.7088	- 0.9245
Southern	-3.0471	1.2218	- 1.6725	- 2.5964	-2.2339	0.9398	- 1.6725	- 1.5013
Central	-0.7106	0.4204	- 0.4378	- 0.6932	0.6214	0.7416	- 0.4378	0.3176
Northern	-0.3444	0.1421	- 0.2335	- 0.2530	0.6547	1.4799	- 0.2335	- 0.5916

	Vegetables			
	Var log (Yield)	**Var log (Prod)**	**Var log (Area)**	**2*[Cov log (Prod, Area)]**
2001	-1.6585	1.2872	- 0.9326	-2.0130
2005	-1.7223	1.0086	- 1.0154	-1.7155
2008	-0.2781	1.6684	- 0.7088	-1.2377
Southern	-3.0057	1.3395	- 1.6725	-2.6727
Central	-0.5749	0.5385	- 0.4378	-0.6755
Northern	0.2967	0.7357	- 0.2335	-0.2054

Number of Observations for years = 17 & Number of Observations for Region: Southern = 32; Central = 48 & Northern = 56. Coffee is not included due to non-availability of data.

Diversification of Agriculture

The *Handbook of Statistics* (2008) disaggregates agriculture into three components: value of crop production, forestry, and livestock and fisheries. Here an attempt is made to analyse changes in the composition of agriculture into these components and the underlying factors[14]. Using IV estimates of these components, we also examine whether the more rapid diversification of agriculture with growing integration of this sector in the global economy is associated with this sector's growth acceleration. The data for this analysis cover the period 1990-2008.

$$\mathrm{LogY}_{ct} = \alpha + \beta_1 \log \mathrm{PublicInvestment}_{t-1} + \beta_2 \log \mathrm{ForeignDirectInvestment}_{t-1}$$

$$+\beta_3 \log \mathrm{TradeShare}_{t-1} + \lambda_{1997-98} + \lambda_{2000-04} + \lambda_{2005-08} + \varepsilon_t \text{...........(6)}$$

where

log of value of crop production, LogY_{ct}, is the dependent variable (c denoting crop, t year) on lagged values of log of Public Investment, log of Foreign Direct Investment, log of Trade Share, and year dummies, λ, with subscripts denoting year/period during which a crisis (1997-98) or policy reforms occurred or culminated[15]. In addition, interactions of public investment, FDI and trade shares, and another set of interactions of these variables with the time dummies are used. The results are given in Table 9.

Let us first consider the factors associated with value of crop production. The main findings are given below:

- The overall effect of public investment in agriculture (direct as well as through its interactions with trade share as well as with year dummies) is positive[16].
- But the effect of FDI (the direct effect as well as its interaction with trade share) is negative, implying that FDI may be displacing public investment instead of complementing it[17].

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[14] This is not to suggest that significant changes within each component (e.g. growing importance of vegetables, fruits) are not part of diversification of agriculture. We hope to throw light on these changes using LECS 4.

[15] As noted earlier, this is a convenient way of circumventing the endogeneity of public investment, FDI and trade liberalization. There is also a related issue of reverse causality (say, livestock or forestry inducing FDI) that must be dealt with in a longer time-series that we did not have access to.

[16] As noted earlier, public investment in agriculture has declined steeply over the years. Also, there are large fluctuations. Finally, as much of public investment goes to irrigation, the rising burden of operating and maintenance costs comes in the way of realising the full benefit of public investment.

[17] Land concessions for plantations (e.g. rubber) on long-term lease often encroach on land used for cultivation. Besides, for a few years the land acquired remains fallow. This explanation is consistent with the mild negative effect of FDI on crop values. We owe this explanation to Dr Somchit Intamith.

- Trade share has a positive effect on the value of crop production (taking into account its direct effect as well as its interactions)[18].
- The overall specification is validated by the F-test. The D-W statistic is in the inconclusive range. A graphical illustration of the predictive accuracy of the specification used is given in Fig: 3.
- How large these effects are can be assessed from the simulations in Table 10. That the potential for growth of crop value is small through modest increases in public investment (5 per cent) is confirmed. Crop

[18] As Dr Parisak emphasised, this effect may well be stronger if illicit trade across borders is accounted for. We do not know whether smallholders benefit greatly from it. For illustrative evidence and implications for policy, see ADB (2010) and LOG (2010).

value increases by barely 0.26 per cent in response to a 5 per cent higher public investment. A 5 per cent higher FDI, on the other hand, is associated with a negligible reduction in crop value of 0.14 per cent. **What is indeed interesting is the large effect on crop value of a modest increase in trade share**. A 5 per cent higher trade share is associated with an increase of over 7 per cent in crop value[19]. **This effect, however, may be less strong for smallholders given their limited participation in trade.**

Using a variant of the specification in equation 6 with the value of forestry products as the dependent variable, the following results are obtained:

- The effect of public investment (direct effect as well as interaction effects with FDI and year dummy) is positive.
- But that of FDI (its direct effect and interactions with public investment and year dummy) is negative[20].
- The effect of trade share is positive (the interaction effect of trade share with the year dummy for 2000-08 more than compensates for the direct negative effect).
- The overall specification is validated by the F-test. The D-W statistic is in the inconclusive range. A graphical illustration of the predictive accuracy of this specification is given in Fig: 3.
- How large are the effects of changes in these variables is illustrated on the assumptions of 5 per cent and 10 per cent increases in the values of these variables. With a modest increase of 5 per cent in public investment, the value of forestry increases by 0.14 per cent-a small increase. A 5 per cent increase in FDI, however, decreases the value of forestry products by a small amount (a little over 1 per cent)**. A 5 per cent increase in trade share, however, has a substantial positive effect on forestry products, as their value rises by over 12 per cent.**

Using another variant of equation 6 for the value of livestock and fishery products, the key results are:

- FDI has a (weakly) significant positive effect on the value of livestock and fishery products while that of public investment is not significant. This may imply FDI substituting for public investment (as opposed to the two being complements).
- However, while the direct effect of trade share is not significant, its interaction with the year dummy (2000-08) is significantly negative. This implies that during this period the effect of trade share was

[19] An extension of this analysis is to instrument trade expansion on the growth of neighbouring economies (China, Thailand and Vietnam).

[20] Land concessions in forestry to foreign investors by provincial governments –often in violation of the national government-are partly to blame. We are grateful to Dr parisak for sharing this view. For illustrations of ad hoc decisions by provincial governments, see ADB (2010) and LOG (2010 a).

significantly lower than in the rest of the sample period. This may be a manifestation of weak demand for livestock products from the neighbouring countries-except China- during the recession.

- The overall specification is validated by the F-test. The D-W statistic is in the inconclusive range. A graphical illustration of the predictive accuracy of this specification is given in Fig: 3.
- The simulations show that, with a 5 per cent higher FDI, the value of this sub-sector is lager by just under 1 per cent-a modest increase.

Table 9
Regression Estimates for Diversification

Dependent Variables	Crops		Forestry		Livestock and Fishery	
	OLS	*Robust*	*OLS*	*Robust*	*OLS*	*Robust*
Explanatory Variables						
Public Investment	3.0177	3.0177	0.7694	0.7694	0.0979	0.0979
	(0.8814)*	(0.8132)*	(0.2573)*	(0.1589)**	(0.0508)+	(0.0558)
Foreign Direct Investment	1.9322	1.9322	1.1918	1.1918	0.1657	0.1657
	(0.9203)+	(0.8675)+	(0.2489)**	(0.1952)**	(0.0741)+	(0.0869)+
Trade Share	12.1287	12.1287	-1.3208	-1.3208	0.1505	0.1505
	(3.6755)*	(3.5041)*	(0.7965)	(0.1420)**	(0.7886)	(0.4196)
FDI*Trade	-0.4718	-0.4718				
	(0.2152)+	(0.2007)+				
Public Investment*Trade	-0.7142	-0.7142				
	(0.2064)*	(0.1889)*				
Year Dummy 1997-1998	0.1259	0.1259				
	(0.0608)+	(0.0616)				
Year Dummy 2000-2004	0.6410	0.641				
	(0.0871)**	(0.0671)**				
Year Dummy 2005-2008	0.5876	0.5876				
	(0.0879)**	(0.0546)**				
FDI*Public Investment			-0.1145	-0.1145		
			(0.0228)**	(0.0187)**		
Pub. Inv.* Year Dummy 2000-2008			0.3066	0.3066		
			(0.1814)	(0.0537)**		
FDI*Year Dummy 2000-2008			-0.3732	-0.3732		
			(0.1033)*	(0.0675)**		
Trade*Year Dummy 2000-2008			3.7423	3.7423	-4.5825	-4.5825
			(0.8958)*	(0.4642)**	(1.0033)**	(0.8650)**
Year Dummy 2000-2008			-15.5903	-15.5903	19.4457	19.4457
			(5.1780)*	(1.7298)**	(4.2444)**	(3.6858)**
Constant	-31.016	-31.016	15.7904	15.7904	16.4953	16.4953
	(15.6695)	(15.0834)+	(5.2819)*	(1.6977)**	(3.3521)**	(1.8869)**
Number of Observations	*13*	*13*	*13*	*13*	*13*	*13*
Adjusted R-Squared	*0.9881*	*0.9881*	*0.9732*	*0.9732*	*0.8442*	*0.8442*
F-Statistics	*41.38***	*113.21***	*18.92***	*86.76***	*7.59***	*8.26***
Durbin-Watson	*2.23*		*2.74*		*2.76*	

Table 10
Simulations for Diversification

	Changes					
	Crops		Forestry		Livestock and Fishery	
Variables	*5 %*	*10 %*	*5 %*	*10 %*	*5%*	*10 %*
Public Investment	0.26 %	0.52 %	0.14%	0.28%		
FDI	-0.14%	-0.27%	-1.03%	-2.06%	0.83 %	1.66%
Trade Share	7.10%	14.20%	12.11%	24.22%		

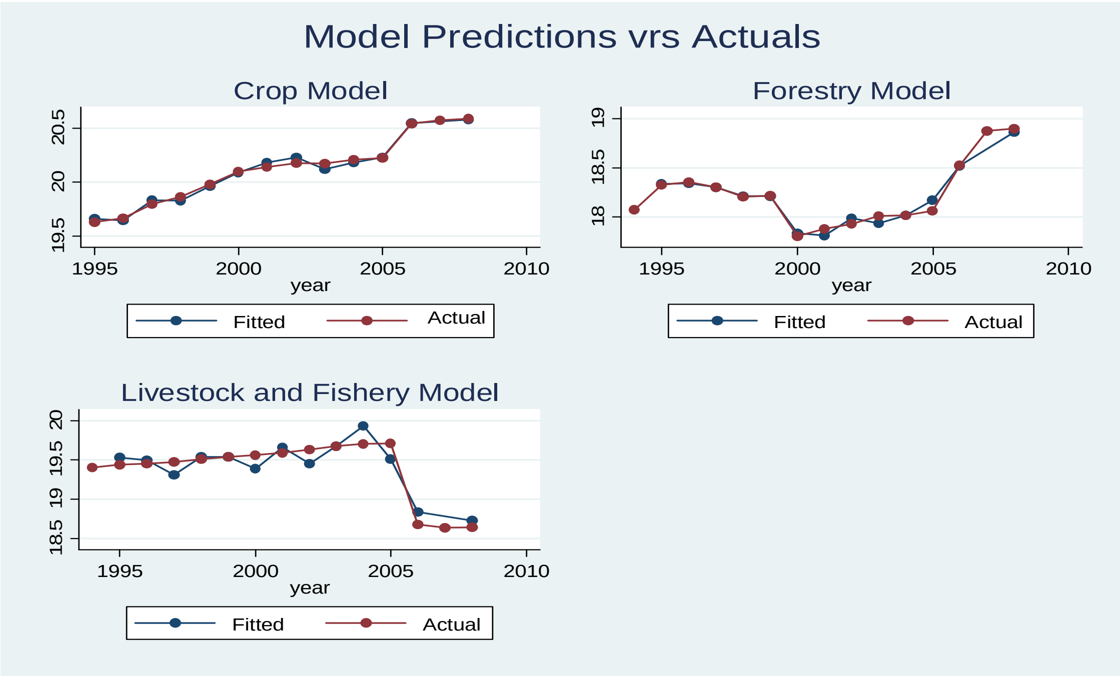

Fig: 3 Predictive Accuracy of Models used for Values of Crop Production, Forestry Products and Livestock and Fishery Products

Agriculture and GDP Growth Rates

Here we first pull together our earlier analysis of the determinants of each component of value added in agriculture (i.e. values of crops, forestry products, and livestock and fishery products. We carry out simulations on reasonable/plausible assumptions of increases in public investment in agriculture, FDI and trade share. The simulation results are given in Table 12.

The base scenario assumes 3 per cent higher (sample mean) values of public investment in agriculture, FDI in agriculture and trade share[21]. Note that there was a marked reduction in public investment in agriculture-in fact, there were large fluctuations over time-and rapid increases in FDI and trade share. These assumptions therefore imply a lower decline in public investment and slight increases in FDI and trade shares over the observed (sample mean) values. These assumptions imply that agricultural value added is likely to grow at 4.20 per cent per annum.

As declining public investment is a matter of concern, we have experimented with larger increases in it (5%, 10 %, 15 % and 20 %) without altering other assumptions in the base scenario. It is interesting to note that for the observed agricultural growth rate of 4.16 per cent to be maintained, public investment has to be larger by just 3 per cent. If fiscal constraints are less binding, a 20 per cent higher public investment would lead to a growth rate of just under 5 percent.

In the next stage, we link agricultural value added to GDP, positing the following relation:

$$\text{Log } GDP_t = \alpha + \beta_1 \log GDP_{t-1} + \beta_2 \log Agriculture_t + \lambda_{2000\text{-}08} + \epsilon_t \text{ ……(?)}$$

This specification allows us to estimate the long-run effect of agricultural growth rate on GDP. As the value of agricultural production is obtained through instrumented values of the three components (i.e. values of crop production, forestry, and livestock and fishery), its own coefficient is a measure of its short-run effect on GDP. A dummy variable for 2000-08 aims to capture the effects of significant policy changes and other changes in the economic environment that cannot be captured with the data available to us. This regression is estimated using annual observations over the period 1990 to 2008. The OLS and robust regression results are given in Table 11, and, based on the robust results, simulations are given in Table 12.

As may be seen from regression results, while GDP is tracked closely by its own lagged value, agricultural value added contributes substantially to it. While the short-run elasticity is about 0.67, and the long-run elasticity is considerably larger (1.59). This implies that a 1 per cent growth in agricultural value added will result in 1.59 per cent GDP growth[22]. The dummy for 2000-08 has a significant but small negative effect. A selection of simulation results obtained from the robust regression is given in Table 12.

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[22] The larger long-run elasticity is based on the steady state assumption. What it really means is that agricultural growth acceleration takes time to percolate to the rest of the economy through employment and output adjustments before reaching a steady state equilibrium.

Table 11
GDP-Agricultural Regression

Explanatory Variables	*OLS*	*Robust*
Lag of GDP	0.5868	0.5868
	(0.1951)**	(0.2193)*
Predicted Agricultural Value Added	0.6748	0.6748
	(0.2957)*	(0.3183)*
Year Dummy for the Period 2000-2008	-0.0207	-0.0207
	(0.0091)*	(0.0077)
Constant	-5.0455	-5.0455
	(1.9726)	(1.9116)
Number of Observations	18	18
Adjusted R^2	0.999	0.999
F-Statistics	7821.07**	15471.30**
Durbin's Alternative Test (Chi-sq)	0.930 (0.3348)	

Standard Errors in parenthesis ** Significant at one per cent; * Significant at five per cent & + Significant at ten per cent.

Table 12
Simulations of GDP Growth under Alternative Agricultural Growth Rates

	CHANGES			RESPONSES	
SCENARIOS	**Public Investment**	**Foreign Direct Investment**	**Trade Share**	**Agricultural Value Added**	**GDP**
1	3	3	3	4.20%	6.86%
2	5	3	3	4.29%	7.01%
3	10	3	3	4.50%	7.35%
4	15	3	3	4.161%	7.69%
5	20	3	3	4.93%	8.05%

We use the robust estimates to examine GDP responses

As discussed earlier, for the observed agricultural growth to be maintained at 4.161 per cent annually, public investment in agriculture is required to grow at 3 per cent, and FDI and trade share at 3 per cent each[23]. Using the long-run elasticity of GDP to agricultural value added of 1.59, this translates into a GDP growth of 7.69 per cent. On an optimistic view of a slightly larger increase in public investment -20 per cent-agricultural growth is likely to be just under 5 per cent and consequently GDP growth would be about 8 per cent.

[23] It is, therefore, intriguing that agriculture and forestry are assumed to grow at 3.4 per cent per annum in LOG (2010 a).

In sum, higher growth rates of agricultural value added and GDP- relative to trend rates - seem feasible. Before examining their implications for MDG 1, let us examine salient features of rural poverty with the help of LECS IV.

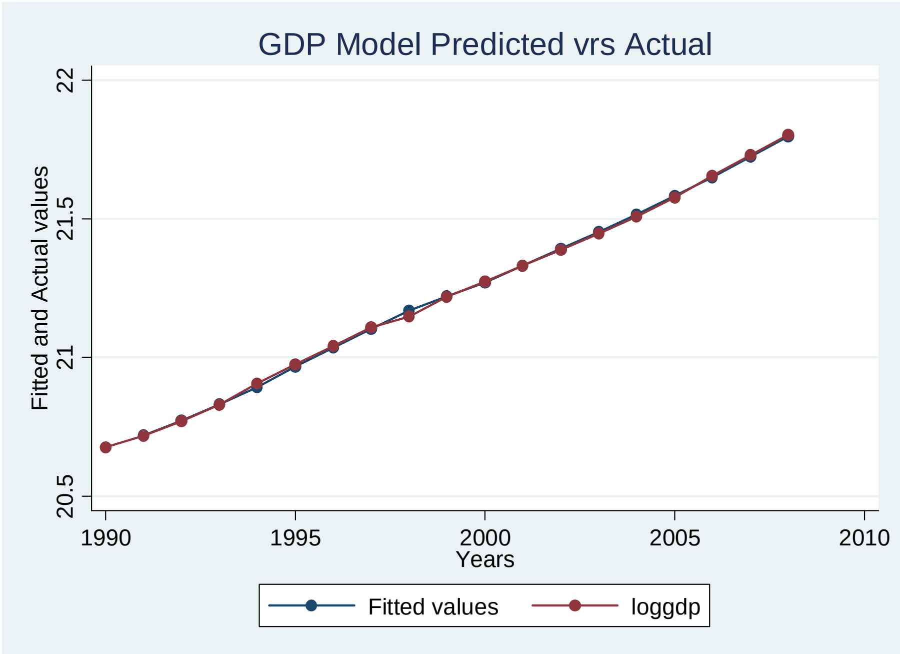

Fig: 4 Predictive Accuracy of Models used for GDP Estimation

Salient Features of Poverty - Temporal and Spatial Variation

A recent Lao Government report (2010 b) offers a comprehensive review of poverty based on the four Lao Consumption Expenditure Surveys (LECS). A distillation of the key findings is given here, followed by our analysis of village level variation in poverty, based on LECS 4.Three sets of poverty estimates are obtained from the total poverty line, food poverty line and the World Bank poverty line of $1.25 (PPP 2005) per day (for convenience of exposition, this is referred to as the dollar poverty line).

In Fig. 4, we have plotted the kernel densities of the three headcount indices against the normal probability density functions (pdf).

- Both overall poverty and food poverty have peaks to the left of the normal peak and slightly fatter tails. These imply that there are higher concentrations of overall and food poverty at lower ranges, as also higher concentrations in the upper tails of the distributions.
- The dollar poverty index also has a peak to the left of the normal pdf peak (but lower than those of overall and food poverty indices), as also a fatter tail than the normal. The latter implies that there is more concentration at higher levels of poverty too.

Let us first consider the temporal change in different indices of poverty, based on the official poverty line:

Table 13
Reduction in Poverty, 1992/93 to 2007/8

Poverty Index	1992/3	1997/8	2002/3	2007/8
Poverty Headcount	46.0 (56.9)[1]	39.1 (49.5)	33.5 (44.4)	27.6 (37.4)
Poverty Gap	11.2	10.3	8.0	6.5
Poverty Severity	3.9	3.9	2.8	2.3

1. Headcount index on $1.25 (PPP 2005).
Source: Lao Government (2010 a)

- The poverty headcount index fell steadily over the period 1992/93 to 2007/8.
- The poverty gap index also registered a reduction.
- The poverty severity index declined too.
- These reductions imply reductions in the incidence of poverty, its intensity and severity. In other words, not only did growth over this period lift a large number of poor out of poverty but the poorest benefited too.
- Similar results are obtained by using the World Bank poverty cut-off of $1.25 per day except that the headcount indices are higher.
- Although reduction in national poverty headcount has been about 3.4 per cent annually since 1992/93, it is plausible to argue that the rate of reduction would have been faster but for adverse distributional changes. A decomposition of poverty reduction into growth and redistribution components suggests that the observed reduction is due to consumption growth. However, the Gini coefficient of consumption expenditure rose between 1992/93 and 1997/98, and thus dampened the contribution of growth to poverty reduction. In the next five years, 1997/98 to 2002/03, growth was accompanied by a reduction in inequality and the two together contributed to poverty reduction. During 2002/3 -2007/8, while strong growth reduced poverty, a rise in inequality weakened this effect (Lao Government, 2010 b).
- Food poverty is defined in terms of cost of food sufficient to provide 2100 calories per day. So a household that is food poor is one that spends less on food required to buy this “food basket”. A household that is overall poor spends less than is needed to buy this basket and non-food items required (e.g. clothing). Comparison of food poverty over the period 1997/98 to 2007/8 is intriguing. While it fell sharply from 32.5 per cent in 1997/98 to 19.8 per cent in 2002/3, there was a reversal in 2007/8 as it rose to 24.6 per cent[24]. Our analysis is designed to throw new light on this aspect of poverty.

[24] In a discussion, Dr Parisak was emphatic that that this could be in part a statistical artefact. A recent World Bank study (2010), for instance, shows that, in 2007/08, in rural areas, 15 per cent of food consumed had been collected from forests and rivers. These include wild plants, animals and insects. For various reasons, this is likely to be a conservative estimate. Also, ethnic minorities are unlikely to be rice-sufficient, instead relying more on consuming roots/tubers. An issue then is whether the reliability of estimates of consumption of wild foods varies over time.

Let us now turn to the spatial pattern. There is substantial regional variation in poverty reduction. Vientiane Municipality saw a rapid fall in poverty in the early and mid-1990s. But it rose during the period up to 2002/3 and then fell in the next five years to 15.2 per cent. Throughout the period the North lagged behind the other regions, with the headcount index of 32.5 per cent in 2007/8 while the South and Central regions experienced more rapid poverty reduction, to 22.8 per cent and 29.8 per cent of the population, respectively.

Poverty remains largely rural. In 2002/3, about 86 per cent of the poor lived in rural areas. This fell to about 81 per cent in 2007/8. Also, the rural headcount index was just under twice as high as in urban areas (31.7 per cent and 17.4 per cent, respectively). Within rural areas, villages connected by road have markedly lower incidence of poverty as compared with those not connected by road (29.9 per cent and 42.6 per cent, respectively). If village altitude is taken into account, the proportion of poor was as high as 42.6 per cent in the uplands, 29.1 per cent in the midlands and 20.4 per cent in the lowlands.

Ethnicity matters a great deal. The Lao-Tai had the lowest incidence of poverty (18.4 per cent) while the Mon-Khmer (47.3 per cent), Chine-Tibet (42.2 per cent) and Hmong-lu Mien (43.7 per cent) had much higher headcount indices.

Evidently, agriculture and geography have important roles in explaining temporal and spatial variation in poverty.

Table 14
Poverty Head Count Drivers at the Village Level

Explanatory Variables	*Poverty*	*Food Poverty*	*Dollar a day Poverty*
Dummy for Midland	0.4514	0.5403	0.3040
	(0.1936)*	(0.1901)**	(0.1924)
Dummy for Upland	0.4278	0.6708	0.3375
	(0.1916)*	(0.1905)**	(0.1724)*
Dummy for Villages without Road	0.4541	0.6097	0.3978
	(0.2014)*	(0.2066)**	(0.1915)*
Proportion of Mon-khmer	1.0090	0.7332	1.0390
	(0.1764)**	(0.1668)**	(0.1651)**
Proportion of Chine-Tibet	0.3994	-0.2722	0.3424
	(0.3234)	(0.3164)	(0.3234)
Proportion of Hmong-lu Mien	0.9045	0.6331	0.8699
	(0.2994)**	(0.2931)*	(0.2872)**
Proportion of Other Ethnic Groups	-0.2304	0.6943	0.5817
	(0.4319)	(0.2813)**	(0.4968)
Constant	-1.5764	-1.8198	-1.0412
	(0.0908)	(0.0904)	(0.0942)
Number of Observations	320	304	336
Adjusted R^2	0.225	0.237	0.205
F-Statistics	12.72**	13.95**	11.53**

Standard Errors in parenthesis ** Significant at one per cent; * Significant at five per cent & + Significant at ten per cent

Table 15
Poverty Head Count Drivers at the Village Level

Variable	*Poverty*	*Food*	*Dollar a day*	*Food Poverty*[1]
Log of Gini	0.8373	1.1701	0.6139	-
	(0.1336)**	(0.1362)**	(0.1238)**	-
Log of Per Capita Consumption	-2.2046	-2.0352	-1.9146	-
	(0.1425)**	(0.1348)**	(0.1295)**	-
Gini	-	-	-	5.6812
	-	-	-	(0.8139)**
Per Capita Consumption	-	-	-	0.0000
	-	-	-	(0.0000)**
Price of Rice	-	-	-	0.0000
	-	-	-	(0.0000)**
Rice Price *Per Capita Consumption	-	-	-	0.0000
				(0.0000)**
Constant	27.0596	25.3198	23.5148	-1.0048
	(1.9071)	(1.7917)	(1.7340)	(0.3202)
Number of Observations	327	308	354	178
Adjusted R^2	0.717	0.581	0.689	0.456
F-Statistics	144.65**	114.61**	136.76**	-

1. We explore the effect of village level price of rice on poverty. 2. Standard Errors in parenthesis ** Significant at one per cent; * Significant at five per cent & + Significant at ten per cent

Table 16
Simulations of Potential Reduction in Poverty

	Changes	
Drivers	1	2
Gini per capita expenditure	1% Decrease	5% Decrease
Per Capita Consumption	1% Increase	5% Increase
Poverty Response	**3.03 %**	**-15.21 %**

The mean headcount index in LECS IV (2007/8) at the village level is 30 per cent and a SD of 0.27. Using the World Bank criterion of $1.25, the mean index is 41 per cent with a SD of 0.2940. The food poverty index is about 25 per cent with a SD of 0.25. In what follows, an analysis of its inter-village variation is carried out. Two sets of regression are carried out on each poverty indicator: one set focuses on geography and ethnicity, and another on per capita expenditure and the Gini coefficient of expenditure.

The reason for running these two separate regressions is the high degree of collinearity between expenditure and the Gini, and geographical characteristics and ethnic groups. The results are given in Tables 14 and 15.

- Although under a quarter of the variation in the poverty indices is explained, the altitude, village access to roads and ethnicity have significant roles in explaining the variation. The overall poverty is higher in the Uplands (relative to the Lowlands); it is also higher in villages without access to roads (relative to those with access); it is higher among the Mon-Khmer and Hmong-lu Mien relative to the Lao-Tai.
- Similar results are obtained for the poor on the $1.25 criterion.
- There are a few differences in the results for food poverty. Both the Midland and Uplands have significantly higher food poverty incidence; among Other Ethnic groups too food poverty is higher relative to the Lao-Tai[25].

Thus, geography, market access through roads and ethnicity have important roles in explaining variation in these poverty indices.

Let us now consider other regressions in which poverty variation is explained in terms of per capita expenditure and the Gini coefficient of expenditure distribution. The results for the three poverty indices are displayed in Table 15 and simulations based on them in Table 16. The results are plausible.

- In all three cases, the Gini has a positive elasticity, implying that a reduction in inequality significantly lowers the poverty indices. It is interesting that the elasticity of the food poverty index with respect to the Gini is the highest.
- Consistent with the poverty literature (see, for example, Imai et al. 2010, and Gaiha and Imai (2009), the headcount indices are negatively related to per capita expenditure with the elasticities ranging from -2.20 (overall poverty) to -1.91 (dollar poverty). These elasticities imply a more than proportionate reduction in poverty for a 1 per cent higher per capita expenditure.
- The simulations in Table 16 illustrate the likely poverty effects for counterfactual scenarios. If the Gini reduces by 1 per cent and per capita expenditure increases by 1 per cent, the headcount index decreases by 3.03 per cent. With these changes in the Gini and per capita expenditure, the food poverty index decreases by 3.2 per cent.

[25] Some experiments were performed with food price indices compiled from LECSIV. But the results were inconclusive, mainly becauae of the patchiness of the price data. When this variable was included in a regression, the sample size reduced considerably. Moreover, as Nina fenton pointed out, it is not clear whether the prices are consumer or producer prices or a mongrel.

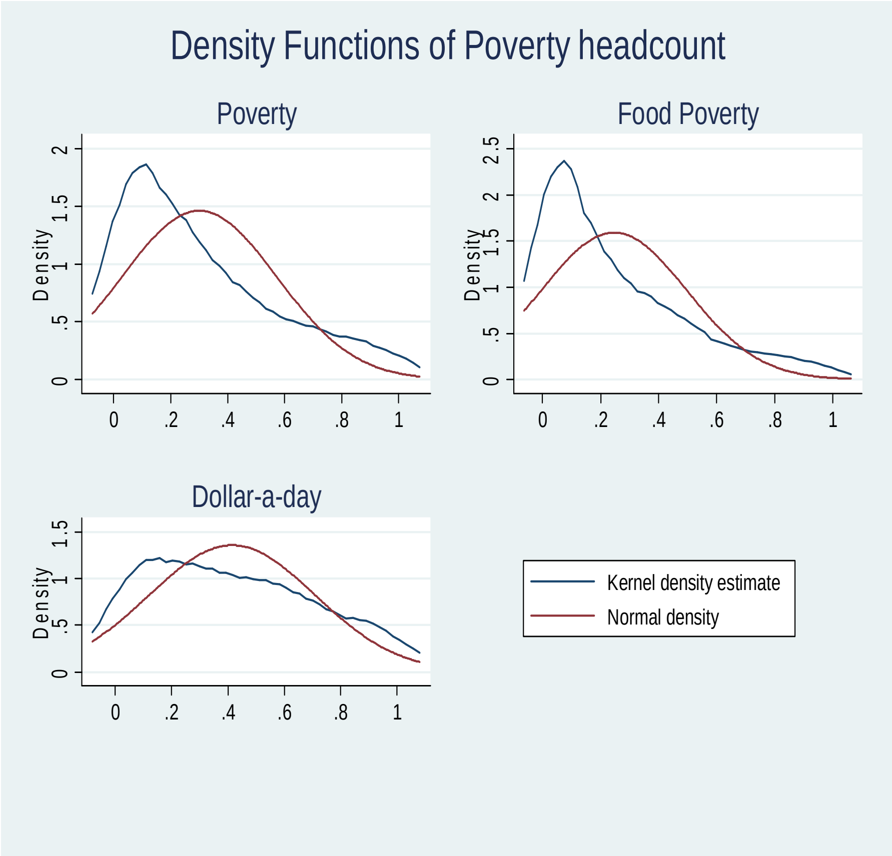

Fig: 5. Distribution of Poverty Headcount Indices

In sum, these results corroborate the strong influences of growth and equity in reducing poverty. In fact, the role of growth is considerably stronger than that of equitable distribution.

Smallholders and Poverty

In this section, we supplement the preceding analysis by focusing on how poverty prone smallholders are.

This analysis is based on the three poverty cut-off points used earlier and the results are given in Tables 17-19

Let us first consider the incidence of poverty in three size categories using the official poverty cut-off point. Note that the average size per household is 2.2 ha. Table 17 reveals an interesting regional contrast. At the national level, the differences in the incidence of poverty are slight. What is somewhat surprising is that proportion of poor is highest in the largest size interval. In Vientiane, by contrast, the highest incidence of poverty is among the smallholders but the lowest is in the medium category. In the North, the incidence of poverty rises with size interval with over one-third being poor. The contrast between Vientiane and the North is also striking in so far as the incidence of poverty in the former is barely 40 per cent of the latter. The Central region also shows high incidence of poverty with more than a quarter poor. There are slight differences across different size intervals but, as in the North, the highest incidence is found in the largest size interval. In the South, as in the Northern and Central regions, more than a quarter of the households are poor. However, the incidence of poverty is about the same in the lowest and highest size intervals and is lowest in the medium category.

The incidence of food poverty is high too, as well over one-fifth of the households suffer from it at the national level. The differences across size intervals are slight with the lowest incidence in the medium size category. In Vientiane, the incidence is much lower than the national estimate. Also, it is highest in the lowest size interval and lowest in the medium category. In the North, the incidence of food poverty is much higher than in Vientiane. Another contrast is in the size distribution of poor. About a quarter of the households in the largest category are food poor and just over one-fifth in the lowest land interval. The Central region also records high food poverty with under a quarter of the households suffering from it. The highest incidence is in the lowest land category and the lowest share in the medium interval. In the South, the incidence of food poverty is (relatively) low. The lowest incidence is found in the medium category and the highest in the lowest land interval.

If we go by the dollar poverty line (i.e $1.25), the Northern and Southern regions are the poorest, with about 40 per cent of the households as poor. At the other extreme is Vientiane, with about 18 per cent as poor. Another striking contrast between Vientiane and the North is that, while dollar poverty is highest in the lowest interval in the former, it is highest in the largest land interval in the latter.

In sum, while the regional contrast in poverty by size interval is striking, it is somewhat intriguing that the incidence of poverty is in some cases higher in the largest land interval than in the lowest. Whether this is a manifestation of differences in access to markets, crops grown, livestock, and productivity requires a more detailed investigation than feasible at the time of writing[26].

[26] ADB (2010), for example, points out that 0ver 90 per cent of all livestock is produced by smallholders, and livestock sales account for more than 50 per cent of cash income for many households.

Table 17

Land Size Distribution by Poverty Headcount

	Entire			Vientiane			North			Central			South		
Land Size Categories	0	1	Total	0	1	Total	0	1	Total	0	1	Total	0	1	Total
Less than 2.2 ha	3,484	1,196	4,680	474	72	546	1,575	631	2,206	1,231	418	1,649	204	75	279
	74.44	25.56	100	86.81	13.19	100	71.40	28.60	100	74.65	25.35	100	73.12	26.88	100
Between 2.2 and 2.5 ha	252	91	343	35	3	38	102	49	151	99	34	133	16	5	21
	73.47	26.53	100	92.11	7.89	100	67.55	32.45	100	74.44	25.56	100	76.19	23.81	100
Above 2.5 ha	1,441	555	1996	165	19	184	518	261	779	629	229	858	129	46	175
	72.19	27.81	100	89.67	10.33	100	66.50	33.50	100	73.31	26.69	100	73.71	26.29	100
Total	5,177	1,842	7,019	674	94	768	2,195	941	3,136	1,959	681	2,640	349	126	475
	73.76	26.24	100	87.55	12.24	100	69.99	30.01	100	74.20	25.80	100	73.47	26.53	100

1. Denotes poor households (%).

Table 18

Land Size Distribution by Food Poverty Headcount

	Entire Sample			Vientiane			North			Central			South		
Land Size Categories	0	1	Total	0	1	Total	0	1	Total	0	1	Total	0	1	Total
Less than 2.2 ha	3,662	1,018	4,680	457	89	546	1,726	480	2,206	1,254	395	1,649	225	54	279
	78.25	21.75	100	83.7	16.3	100	78.24	21.76	100	76.05	23.95	100	80.65	19.35	100
Between 2.2 and 2.5 ha	275	68	343	35	3	38	113	38	151	108	25	133	19	2	21
	80.17	19.83	100	92.11	7.89	100	74.83	25.17	100	81.2	18.8	100	90.48	9.52	100
Greater than 2.5 ha	1552	444	1996	159	25	184	584	195	779	667	191	858	142	33	175
	77.76	22.24	100	86.41	13.59	100	74.97	25.03	100	77.74	22.26	100	81.14	18.86	100
Total	5,489	1,530	7,019	651	117	768	2,423	713	3,136	2,029	611	2,640	386	89	475
	78.20	21.80	100	84.77	15.23	100	77.26	22.74	100	76.86	23.14	100	81.26	18.74	100

1. Denotes poor households (%).

Table 19

Land Size Distribution by Dollar Poverty

	Entire Sample			**Vientiane**			**North**			**Central**			**South**		
Size Distribution Categories	*0*	*1*	*Total*	*0*	*1*	*Total*	*0*	*1*	*Total*	*0*	*1*	*Total*	*0*	*1*	*Total*
Less than 2.2 ha	2993	1687	4680	442	104	546	1,344	862	2,206	1,041	608	1,649	166	113	279
	63.95	36.05	100	80.95	19.05	100	60.92	39.08	100	63.13	36.87	100	59.5	40.5	100
Between 2.2 and 2.5 ha	220	123	343	33	5	38	89	62	151	85	48	133	13	8	21
	64.14	35.86	100	86.84	13.16	100	58.94	41.06	100	63.91	36.09	100	61.9	38.1	100
Greater than 2.5 ha	1234	762	1996	157	27	184	451	328	779	521	337	858	105	70	175
	61.82	38.18	100	85.33	14.67	100	57.89	42.11	100	60.72	39.28	100	60	40	100
Total	4447	2572	7019	632	136	768	1,884	1,252	3,136	1,647	993	2,640	284	191	475
	63.36	36.64	100	82.29	17.71	100	60.08	39.92	100	62.39	37.61	100	59.79	40.21	100

1. Denotes poor households (%).

Prospects of Achieving MDG 1

Here we analyse the implications of different agricultural and GDP growth rates for halving of the dollar poverty in 1990 by 2015. As we have access to four estimates of this measure (for 1992/93, 1997/98, 2002/3 and 2007/8), we compute the elasticities of poverty with respect to GDP and agricultural value added. These elasticities are given in Table 20.

Table 20
Poverty Elasticity, Growth Rates and MDG1

Year	H(%)	LogH	LogGDP	LogAgr	Pov. Elas.(GDP)	Pov. Elas. (Agr)
1992	55.68	4.02	20.77	20.25	.	.
1997	49.32	3.90	21.10	20.45	-0.3596	-0.5853
2002	43.96	3.78	21.39	20.66	-0.4121	-0.5521
2006	37.44	3.62	21.65	20.83	-0.5993	-0.9719
Average					**-0.4570**	**-0.7031**
				g_{half}	0.0616	0.0396
				Required Growth Rate[1]	6.16% (6.70%)	3.96% (4.31 %)

1. The required growth rates are computed on the assumption of a gap of 25 years (1990-2015). To allow for a shorter gap of 23 years (as the base poverty index is available for 1992), alternative growth rates are computed (shown in parentheses).

We have used the procedure by Besley and Burgess (2003), shown below. to compute the growth rates of GDP and agricultural value added required to halve the poverty index (g_{half}) in 25 years (i.e. over the period 1990-2015). The η denotes poverty elasticity with respect to GDP (or agricultural value added). It is interesting to note that the poverty-agricultural value added elasticities (in absolute value) are greater than the poverty-GDP elasticity, confirming the more important role of agricultural growth in reducing poverty. In fact, this is in marked contrast to the elasticities obtained from large cross-sections of developing countries where the effect of GDP is considerably stronger[27].

$$g_{half} = \frac{\log\left(\frac{1}{2}\right)}{25\eta} \quad \text{..........( )}$$

As may be noted from the results (regardless of whether the gap is 25 years or 22 years), the required rates of GDP and agricultural value added are lower than the feasible range predicted by our simulations. So, if the trend growth rates are maintained, Lao PDR is on track to achieving the MDG1.

In brief, the prospects of achieving MDG 1 are highly likely.

[27] For details, see Imai et al. (2010).

Concluding Observations and Policy Challenges

The main findings and key policy challenges are summarised below.

- **Agricultural intensification could potentially make a substantial contribution to agricultural growth –in fact, our results show a more than proportionate increase in agricultural value added with intensification. The effects may not be as large for the smallholders given their inability to afford mechanisation.**
- As low crop yields and their variability are a major concern-value of crops accounts for well over 80 per cent of agricultural value added-we analysed spatial and temporal variations in 4 major crops viz. rice/paddy, maize, coffee and vegetables. Our analysis based on province level data shows that there are positive trends in yields of all crops except coffee. At the regional level, all crop yields show positive trends except coffee which has a significant negative trend. In the central zone, both maize and all four crops taken together show positive trends. In the northern zone, rice, maize, vegetables and all 4 crops (the combined measure) show significant positive trends**. So there is a regional contrast in the growth of crop yields .**
- The mean rice yield rose between 2001 to 2005 while its variability decreased. Over the more recent period, 2005-08, the mean remained unchanged but the variability rose slightly. The vegetables' yield rose more than moderately over the period 2001-05 while the variability fell. Over the more recent period, the mean fell but with a sharp rise in the variability of the yields. The highest regional yield was in the Central region (about 3.53 tonnes) while the lowest was in the Northern region (about 2.90 tonnes). The variability was highest in the Central region too while the lowest was in the Northern region. **In sum, a mixed pattern is revealed with fluctuating yields and rising variability over the period 2001-08.**
- Our simulations with province level data show that a 5 per cent increase in the share of irrigated area is associated with a 1 percent higher rice yield, 0.42 per cent higher maize yield, and a little over 1 per cent higher yield of vegetables. For all four crop yields taken together, the increase is about 0.81 per cent. **This further corroborates the role of intensification in raising value of crops.**
- Another important aspect of agriculture is its diversification. Disaggregating agriculture into three components: values of crops, forestry products, and livestock and fisheries, we analysed the factors underlying their growth over time. This perspective is useful as it allows us to assess the potential for growth through three policy-related variables: public investment in agriculture, FDI in agriculture and expansion of trade through trade liberalisation.
- As far as the value of crops is concerned, (i) **the overall effect of public investment in agriculture is positive but small**; (ii) somewhat surprising is the mild negative effect of FDI, implying substitutability between public investment and FDI and/or land concessions for, say, rubber

plantations that encroach on areas used for growing crops; and (iii) **the large positive effect of trade share (as a proxy for trade liberalisation**).

- Turning to the value of forestry products, the following results are obtained: (i) the effect of public investment is positive ; (ii) but that of FDI is negative but small 9for reasons similar to those associated with a mild negative effect on crop values); and (iii) that of trade strongly positive.
- Finally, **FDI has a positive but small effect on livestock and fishery value added.**
- On plausible assumptions of a slower decline in public investment and slightly higher FDI and trade, agricultural value added is likely to grow at 4.20 per cent per annum. It is interesting to note that for the observed agricultural growth rate of 4.16 per cent to be maintained, public investment has to be larger by 3 per cent. **If fiscal constraints are less binding, a 20 per cent higher public investment would lead to a growth rate of just under 5 percent. The benefits to smallholders may not be so large given their limited participation in trade. As there is a great deal of illicit trade across borders, it is, however, difficult to be certain about the benefits to smallholders.**
- While the short-run elasticity of GDP to agricultural value added is about 0.67, the long-run elasticity is 1.59. **This implies that a 1 per cent growth in agricultural value added will result in 1.59 per cent GDP growth. So the trend rate of growth of agriculture (4.16 per cent) is associated with** a GDP growth of 7.62 per cent. On an optimistic view, agricultural growth is likely to be just under 5 per cent and consequently GDP growth would be about 8 per cent. **In sum, higher growth rates of agricultural value added and GDP-relative to trend rates – are not overoptimistic.**
- Our analysis of inter-village variation in the three indices of poverty, based on LECS IV, confirms the important roles of geography, market access and ethnicity. A related analysis **corroborate the strong influences of growth and equity in reducing poverty. In fact, the role of growth is considerably stronger than that of equitable distribution.**
- While the regional contrast in poverty by size interval is striking, it is somewhat intriguing that the incidence of poverty is in some cases higher in the largest land interval than in the lowest. Whether this is a manifestation of differences in access to markets, crops grown, livestock, and productivity requires a more detailed investigation than feasible at the time of writing
- The poverty-agricultural value added elasticities are consistently much larger than poverty-GDP elasticities, confirming the key role of agricultural growth in reducing poverty. The required rates of GDP and agricultural growth consistent with achieving MDG 1 are close to trend rates and lower than those predicted by our analysis. **So Lao PDR is on track to achieving this goal.**

Although it was difficult to disentangle the effects of policy-related variables – specifically, public investment in agriculture, FDI in agriculture and trade expansion- our analysis corroborated the positive effects of public investment and, more importantly, trade expansion in agricultural growth acceleration and through its long-term effect on GDP growth. As maintaining trend growth rates in agriculture and GDP require *gradual* reversal of the decline in public investment and expansion of FDI and trade, careful attention must be given to policy measures.

From this perspective some key policy challenges are reviewed below.

Eradicating rural poverty in a durable way requires sustainable use of the resources on which the community depends – land, water, forests and, in the longer term, market-oriented approaches that increase the income and earning opportunities of the rural poor. Rural populations also play a critical role in managing and conserving the natural resources, including its bio-diversity**.**

Effective rural development approaches must also respond to persistent inequality endowments and access markets and public services (such as extension, training and credit) - especially of smallholders and various ethnic groups and other vulnerable sections located in the Uplands and other remote areas.

Improving the efficiency and quality of production, as well as diversification into high value added items, require the provision of necessary support services. Provision of these services is limited owing to budgetary, institutional and technical constraints. Even when these services are available, small farmers are in a disadvantaged situation in accessing them. Assistance for diversification into higher- valued products and filling the gaps in local support systems such as the provision of information, technical advice and quality control is crucially important.

Barriers to market access restrict trade expansion-specifically regulations implemented under SPS (sanitary and phytosanitary), TBT (technical barriers to trade) and TRIPS (Trade-Related Aspects of Intellectual Property Rights). Also, importing firms impose quality and other requirements. These are often more important than governmental regulations. Effective market “entry” can only be realized by satisfying all these requirements. Investments are necessary to understand and comply with the various requirements, both governmental and private. Rural poor do not have the means to undertake these investments. Moreover, modern commodity markets, which increasingly concentrate on large-scale importing, require small producers to be organized for steadily supplying the necessary quantities, even if they can meet and ensure quality and other requirements. Regardless of the price situation, successful participation in international value chains calls for strong producer groups. Assistance is necessary to enable the producers, particularly the smaller ones, to undertake the necessary investments for meeting market entry requirements.

The flow of foreign direct investment (FDI), which increased significantly during the last decade but has declined more recently, remains highly uneven and directed mainly outside the agricultural sector. Effective policy reform programmes are needed to create an enabling environment that encourages private sector investment in rural areas promoting farming, marketing, processing and input supply.

Above all, a priority is improvement in institutional quality. World Bank institutional quality indicators tell a grim story[28]. The indicators that registered deterioration over the period 1996-2008 include voice and accountability, government effectiveness, and management of corruption. As institutional quality is crucial to policy reforms and growth, careful attention must be given to greater transparency in public decision-making and better coordination between policies at different levels.

[28] Details are given in Table A6

Annex

Table A1

Summary Statistics for Agricultural Production Function

Variables	Observations	Mean	Standard Deviation
Agricultural Value Added [a]	17	663,000,000	151,000,000
Machinery [b]	17	955.29	107.60
Irrigated Area [c]	17	167.65	58.38
Fertilizer [d]	17	3872.71	3541.80
Seeds [e]	17	99597.12	22280.93

1.Data is restricted to the period 1985-2001; a. measured in constant 2000 US$; b. measured in terms of number of tractors in use; c. measured in terms of area (1000HA); d. measured in tonnes consumed and e. measured in tonnes (aggregate).

Table A2

Summary Statistics for Crop Yield Regression

Variables	Observations	Mean	Standard Deviation
Rice	136	3.17	0.48
Maize	136	3.34	0.95
Coffee	49	0.79	0.78
Vegetables	136	6.79	1.93
Yield for all four Crops	136	13.58	2.62
Share of Total Irrigated Area	136	0.4	0.21
Share of Dry Irrigated Area	136	0.32	0.1
Total Dry Irrigated Area	136	9649.47	10724.74
Total harvested Area	136	61727.28	42903.19
Total Irrigated Area	136	26520.28	23950.62

Table A3

Summary Statistics for Diversification Regression

Variables	Observations	Mean $^{\tau}$	Standard Deviation $^{\tau}$
Crops	19	19.98450	0.3532
Forestry	19	18.0634	0.4819
Livestock and Fishery	19	19.3511	0.3473
Public Investment	14	8.9509	1.5092
Foreign Direct Investment	17	9.14850	1.4942
Trade Share	18	4.1531	0.2623

τ - Values are in natural logs

Table A4
Village Poverty Level Summary Statistics

Variables	*N*	*Mean*	*Standard Deviation*	*Skewness*	*Kurtosis*
Poverty	390	0.3003	0.2730	0.9002	2.8746
Food	390	0.2462	0.2509	1.1345	3.5217
Dollar a Day	390	0.4148	0.2940	0.3507	2.0689
Gini	390	0.2233	0.0858	1.4638	6.4245
Per Capita Consumption	390	260790	133871	3.0524	19.2809
Price of Rice	238	248376	453605	9.3103	112.5705

Table A5
Summary Statistics GDP-Agricultural Regression

Variables	*N*	*Mean*	*Standard Deviation*
GDP	19	21.2163	0.3504
Agricultural Value Added	19	20.5375	0.2345

Values are in logs and at constant USD

Table A6
Institutional Quality Indicators for Lao PDR

Year	Voice and Accountability	Political Stability	Government Effectiveness	Regulatory Quality	Rule of Law	Corruption
1996	-1.08	1.02	-0.07	-1.62	-1.85	-1.18
1997	-1.06	0.35	-0.36	-1.33	-1.42	-0.94
1998	-1.03	-0.32	-0.65	-1.03	-0.99	-0.69
2000	-1.23	-0.73	-0.76	-1.48	-1.00	-0.92
2002	-1.75	-0.26	-0.74	-1.31	-1.08	-0.92
2003	-1.72	-1.05	-1.03	-1.37	-1.18	-1.01
2004	-1.55	-0.58	-0.92	-1.23	-1.07	-1.10
2005	-1.67	-0.28	-1.01	-1.20	-1.10	-1.16
2006	-1.64	0.01	-0.79	-1.15	-0.99	-1.12
2007	-1.66	-0.04	-0.87	-1.08	-0.98	-1.04
2008	-1.71	-0.01	-0.84	-1.25	-0.90	-1.23
Δ00/08	***0.390244***	***-0.9863***	***0.105263***	***-0.15541***	***-0.1***	***0.336957***

Source: World Bank Governance Data. Negative values denote weak institutions and positive values indicate strong institutions. Values range between -2.5 and 2.5.

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