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No. 7 March 2002

National Institute of Public Finance and Policy
New Delhi

MARCH 2002

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Abstract: This paper calculates per hectare rates of levy for a land-based crop-specific agricultural tax on eight major field crops, based on published Cost of Cultivation data, now available at state-level for the nineties but with uneven coverage across states. The eight crops are paddy, wheat, groundnut, rape/mustardseed, sugarcane, cotton, potato and onion. Clearly, any reconfiguration of input subsidies presently available to agriculture will alter the taxable surplus parameters and levy rates estimated, but the method used is of perfectly general applicability. The state-level rates of levy calculated for the year 1996-97 yield an estimated tax revenue of Rs 500 crores, around 80% of aggregate land revenue collected that year from agricultural land. The levy is envisaged for panchayat rather than state-level, with jurisdictional retention for infrastructure improvements within agriculture. District-level rates of levy, with taxable surplus parameters adjusted for crop yield variations across districts, are calculated for four selected states: Andhra, Punjab, Rajasthan and West Bengal. Revenue additionality at panchayat level as a percent of own revenue collections, aggregating across all panchayat tiers, ranges between 30 percent in Andhra, and 201 percent for West Bengal.

JEL Classification: H71; Q12

Keywords: agricultural taxation, crop-specific levies.

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REVENUE ESTIMATES FOR A CROP- SPECIFIC AGRICULTURAL TAX

1. INTRODUCTION

There is a critical need at the present juncture for reforms in the agriculture sector, and widespread recognition of the need for spatially-dispersed infrastructure to achieve wide-based improvements in agricultural productivity. This paper assesses the possible revenue yield from a crop-specific levy on eight major field crops, levied in a spatially-dispersed manner at the panchayat level of government and jurisdictionally retained for infrastructure improvements within agriculture. Jurisdictional retention holds the key to enforcement of compliance with such a tax.

An agricultural tax must be crop-specific, because of the high variability of returns to land across crops even within a region. Also, an equitable tax in the absence of perfect risk markets must carry a catastrophe exemption provision for yield failure, whether specific to a cultivator (idiosyncratic) or extending to a whole region (non-idiosyncratic). The outlines of such a crop-specific levy were provided in Rajaraman and Bhende, 1998, with an informationally parsimonious design which requires updated information only on area sown to taxable crops, and identification of those cultivators in each list whose yield falls above the exemption threshold yield. The limitations of that scheme were that it required region-specific field surveys to generate two critical parameters, the taxable surplus parameter for each crop, and the threshold yield.

Since October 1999, there is a crop insurance scheme in place, extending to all major cereal and commercial crops; details of the scheme which provides cover for yield failure below a prescribed threshold are given in an appendix. Although this is an area-based scheme, not therefore covering idiosyncratic risk, it removes the need to that extent for an exemption provision for non-idiosyncratic risk, although not all states participate in the scheme (see appendix I). The levying panchayat is at all times free to use the same yield threshold to exempt idiosyncratic yield failure specific to an individual farmer.

This leaves only the need for a region-specific taxable surplus parameter for each crop, that can be applied each year to per hectare revenue to generate the levy per hectare. In the absence of field surveys, the only available source from which the taxable surplus parameter can be estimated is the Commission on Agricultural Costs and Prices (CACP) which episodically publishes cost of Cultivation (COC) data for some selected crops. This paper uses data from the most recent report covering the nineties to calculate the tax revenue potential from eight field crops – paddy, wheat, groundnut, rape/mustardseed, sugarcane, cotton, potato and onion. Farm-level COC data are not available, so all calculations are based on published data at state-level.

Clearly, any reconfiguration of input subsidies presently available to agriculture will alter the taxable surplus parameter and levy rates estimated in this paper. The burden of the paper is not to set rates of levy in concrete so much as to illustrate the method by which to set levy rates from the published COC data.

Agricultural income is exempted from the Central income tax, and is taxable only by state governments, under the separation of taxation powers preserved under the Indian Constitution.[1] At state-level, there is the land revenue, and an agricultural income tax levied today only on plantation agriculture. The levying states are not among the highest in terms of share of agriculture in state GDP (Rajaraman, 2000). Clearly the feasibility of taxing

[1] Article 246 in conjunction with Entry 46 in List II of the Seventh Schedule. However, agricultural income is legally taken cognisance of for determination of slab rates of Central income tax on non-agricultural income since 1973. Agricultural property has also been subjected

agricultural income has more to do with the presence of plantation agriculture than with the importance of agriculture in the state economy. India is not unique in this respect. A 1993 survey found income taxation of agriculture in developing countries only where there is plantation agriculture (FAO, 1993). The land revenue by contrast remains a universal levy. There are only six states not levying land revenue, as contrasted with the agricultural income tax which is levied only by six states.

Agriculture, especially in a developing country like India, differs from industry in three critical respects, which make a conventional income tax infeasible except on plantations. Books of accounts are not maintained except in the plantation sector. In the non-plantation sector, cash transactions not routed through the banking system pose insurmountable barriers to verification and assessment of self-declared income. The spatial spread of agriculture necessarily calls for a more decentralised tax administration network. Together these add up to a critical information vacuum that can only be surmounted by adopting a norm-based approach. This is borne out by the greater universality of the land revenue, which is a norm-based levy.

The combined tax collection from land revenue and the agricultural income tax amounted to Rs 1273 crore in 1998-99, a mere 0.6 per cent of total national tax revenue aggregating across Centre and states, and 1.4 per cent of tax revenues collected by the states. Land revenue accounted for over 81 per cent, a revenue share consistent with its wider incidence than the agricultural income tax.

Normalising the share of direct tax revenue sourced from agriculture by the share of agriculture in GDP yields an agricultural (explicit) taxation coefficient as low as 0.02. The long-term goal should be to raise this coefficient towards

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to Central wealth (1970-83) and capital gains (1961-70) taxation. All these inclusions in the Central sphere have proved consistent with the Constitutional separation of powers.

one, keeping in mind the important caveat that the coefficient does not net out explicit subsidies, and does not include implicit taxation. The case for explicit taxation of agriculture can only rest on objective evidence of the lifting of the suppression of agricultural incomes, introduced as an equity measure to keep down prices of food during the pre-reform planning period. The intersectoral terms of trade have certainly moved in favour of agriculture post-reform (Rajaraman, 2000; Vyas 2001), an indication that implicit taxation of agriculture has reduced, but not that it has been eliminated.

It has been argued elsewhere (Rajaraman, 2000) that the solution to poor state revenues from agriculture is not to attempt Central taxation of agriculture, but to transfer powers to a lower more spatially dispersed level of government. The informational disability confronting state governments will if anything be worse at Central level.

Agricultural land is an important productive asset, in inelastic supply, and unequal in its distribution. From the viewpoint of both efficiency and equity therefore, it is a natural base for taxation, in proportion to its potential output. There is a mainstream consensus on this (Ahmed-Stern 1989; Rao 1989). *In rem* levies (on land regardless of ownership characteristics) are administratively superior to *in personam* levies, whose only advantage is that they permit progressivity in the rate structure.

Section 2 summarises the earlier scheme outlined in Rajaraman-Bhende 1998. The section also briefly covers the literature on capitalisation of the land tax. Section 3 describes the CACP data, and the criterion used to select eight crops. Section 4 examines the constituent costs of the CACP surveys, and defines the cost concept used in this paper for the determination of taxable surplus. The section also presents regression results for the functional relationship between taxable surplus and crop yield for each crop across states. The regressions establish that the taxable surplus parameter for each crop should be anchored to an average of a set of years chosen by similarity of yield rather than contiguity in time, separately for each state. This is done in Section 5. Section 6 uses those parameters to estimate levy rates per hectare for 1996-97, at the anchored yields. Section 7 uses the regression results of section 4 to obtain adjusted levy rates, also for 1996-97.

Section 8 uses the methodology of section 7 to obtain district-level levy rates for four selected states: Andhra Pradesh, Punjab, Rajasthan and West Bengal.

Section 9 concludes the paper. Several appendices present details of the underlying methods and calculations, and there is an appendix on the crop insurance scheme presently on offer nationally.

2. THE SCHEME

The case for a crop-specific approach to agricultural taxation is predicated on the assumption that returns to cultivation are not equalised by cropping pattern shifts, even within a homogeneous agro-climatic region. Any of a number of barriers to entry, ranging from factor-specificity to insufficiency of irrigation or credit can prevent factor shifts to the most profitable crop in a region. Empirical evidence from a study of returns to three commercial crops in Northern Karnataka (Rajaraman-Bhende 1998) shows a difference by a factor of as much as 18.6 between the highest and lowest return crops on irrigated land; and a lower factor of 13.9 between the highest return crops on irrigated and rainfed land. The Maharashtra levy on sixteen commercial crop categories carries a factor of 9.5 differential between the highest and lowest rates of levy per acre.

Although there could in principle be a nationally-prescribed list of taxable crops, there has to be variation across regions in respect of which crops, from among this list, is actually chosen for taxation. In a country as agro-climatically diverse as India, productivity variations can be so wide as to straddle a crop on either side of the taxable income threshold across regions. Even if a nationally uniform crop list is prescribed, there cannot possibly be uniformity across regions in the rate of levy per acre sown to the crop.

The scheme suggested in Rajaraman-Bhende for a panchayat-level crop-specific levy per hectare required a field survey to provide for each crop the following parameters which could then be retained as constants for future years.

Y : Threshold yield, specified in physical units per acre (or other land unit).

ψ_{ij} : [TR-TC]/TR at Y for the ith crop in the jth region.

Since the scheme required stability in the cost/revenue relationship, the threshold was defined as the lower limit of the observed yield domain over which such stability obtains. The only recurring information for assessment purposes required by the levying panchayat was:

a. A listing of cultivators growing each of the crops in the selected subset for each season;
b. Identification of those cultivators in each list whose yields fall below a stipulated exemption yield (failure) threshold.

That scheme continues to carry validity. The disadvantage of the scheme is not the recurring information requirements, but the initial field survey. The levy rates proposed in this paper are therefore based on secondary sources in the public domain which are easily accessed.

3. SELECTION OF TAXABLE CROPS

The published reports on the cost of cultivation (COC) surveys provide no data at the level of the holding, and are confined to state-level averages.

Therefore, the kind of holding-level data required for prescription of the taxable yield threshold of section 2 were not available. The best that could be done with the state-level COC figures was to calculate the taxable surplus at the average (state-level) yield anchored to some selected years. This section covers a few basics about the COC surveys, and the criterion used for selection of potentially taxable crops.

COC surveys have been conducted since 1970-71 by the Ministry of Agriculture, Government of India, but the first published report was issued only in 1991. The third and latest in 2000 covers the nineties. The methodology of measuring revenue and cost has remained essentially uniform over the years, with a few alternative estimates of labour cost added on after a review in 1990.[2] This paper is confined to data for the nineties, as issued in the latest COC report. The latest year reported varies but is either 1996-97 or 1997-98 for most crops and states.

The COC surveys cover traditional crops ranging across cereals, pulses, oilseeds and commercial crops. But coverage of horticultural crops is confined to potato and onion. Newer `sunrise' crops known to be lucrative, such as grapes, flowers, and seed propagation are not covered at all. For all the given crops the report however provides a host of valuable information that includes (1) value of main and by products; (2) physical yield; (3) input quantities and prices; and (4) detailed break-up of cost items, both paid out and imputed. Family labour/managerial services, owned land and owned capital are imputed. All costs are given per hectare.

The main problem in selecting the crop-state cases for study stems from the unevenness of coverage in the published report, in terms of years and crops covered across states. For example, there are data only on two years for Bihar,

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2 See section 4.

and no data on paddy in Tamil Nadu even though the crop accounts for more than 30 percent of gross cropped area in the state.

The final sampling unit is the agricultural holding, chosen through a three-stage stratified random sampling design with the tehsil at the first stage, and the village at the second stage selected with probability proportional to the area under the selected crop. The operational holdings in a village/cluster are enumerated and classified uniformly into five size classes and in each size class two holdings are selected by simple random sampling without replacement.

The selected threshold in terms of total farm revenue per hectare for the initial selection of crops for examination was Rs 10,000 per hectare, inclusive of both main and by products. The triennium 1994-97 had the largest coverage of states, and was therefore the pivot for case selection. The period was retained even if published data were available for only two out of three years for a particular state or crop.[3] Details of coverage for each crop are given in appendix table A3.1. Urad and maize were eliminated owing to low farm revenue potential. Gram-UP and soybean-MP had to be excluded because of insufficient data points.

A simple ranking of states by value (Rs/hectare) of crops selected for the taxability examination is presented in table 3.1. Andhra Pradesh, Haryana and Punjab are among the highly ranked states for many crops. Madhya Pradesh at the other extreme has a low rank in value realised in all but soyabean. The two horticultural crops are confined for data availability reasons to one state each, West Bengal for potato and onion for Maharashtra.

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3 Even if only one of the three years was covered, the case was selected if (a) average revenue crossed the threshold and (b) data were reported for at least one other year to conduct the study.

Table 3.1

Ranking of States by Value (Rs/Hectare) of Output: Cropwise

Rank	Paddy	Wheat	Ground nut	Rape & mustard	Sugar cane	Cotton	Potato	Onion
AP	1	-	5	-	3	2	-	-
HR	3	1	-	2	5	1	-	-
PJ	2	3	-	6	-	5	-	-
UP	5	4	-	3	6	-	-	-
MP	7	6	-	5	-	8	-	-
MH	-	-	4	-	4	7	-	1
RJ	-	2	-	4	-	3	-	-
TN	-	-	1	-	1	4	-	-
KN	-	-	-	-	2	-	-	-
WB	4	7	-	-	-	-	1	-
OR	6	-	2	-	-	-	-	-
AM	8	-	-	7	-	-	-	-
GJ	-	5	3	1	-	6	-	-
HP	-	8	-	-	-	-	-	-

Source: Appendix table A3.1.

4. TAXABLE SURPLUS AS A FUNCTION OF CROP YIELD

This section outlines the procedure used to estimate the parameter, ψ, from published COC data. This parameter can then be applied to available information on revenue per hectare in any year to obtain the taxable surplus, as described in section 2.

The Cost of Cultivation publications provide data by crop on state-level averages of TR/hectare, from the sum of main and by products, valued at prevailing post-harvest prices, along with three alternative measures of total cost as listed below.

1. C2 = actual paid-out cost with family owned inputs imputed at market prices.
2. C2* = C2+Incremental cost of human labour at statutory wage rate if higher than market wage.[4]
3. C3 = 1.1 x {C2*}, with the managerial input of the farmer imputed at 10 percent of all input costs.[5]

The method of imputation of managerial cost, implying an increase when prices of inputs such as fertiliser go up, is clearly unsatisfactory. The application of the managerial addition to C2* rather than C2, imparts a further degree of inflation to the cost estimate C3.

For taxation purposes, it is actual cost C2, rather than the hypothetical C2*, that is clearly the more appropriate in eliciting the true taxable potential. A further cost estimate in this paper, M3, is defined thus, basing managerial cost on labour cost alone.

M3 = C2+ 10% of human labour cost.

The rental value of leased land is commonly included in cost where land is leased in, and imputed for own land. The latter signifies the cost foregone by not leasing out the land. However, in the context of tax potential, the rent foregone also constitutes a taxable income as it represents payment that the owner receives from himself rather than from a different lessee. Thus, while rental value of own land does constitute cost (and so should be subtracted from revenue to obtain surplus), it also represents taxable income to the farmer (and should be

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4 Cost specification C2* is the additional alternative estimate of cost introduced in 1990, referred to earlier.

5 Estimate C3 was an outcome of an Expert Committee's recommendation that managerial costs be added on.

added back). The relevant cost specification for computing the taxable surplus is therefore one in which rental value of own land is not included.

The adjusted cost specification computed here as the more appropriate for taxation purposes is given by M3adj:

M3adj= C2 + {0.1 X Human Labour cost } - Rental value of own land

Based on this estimate of cost the surplus parameter ψ can be expressed as

ψ = [(TR-M3adj)/TR] X 100

where ψ gives an estimate of taxable surplus as percentage of total revenue.

The regression investigating the functional dependence if any of the taxable surplus parameter on crop yield, was based on pooled data for all states for each crop. The two horticultural crops were clubbed together for lack of enough data on each. A preliminary view of the scatters suggested a distinct positive relation in all cases except two. The exceptions are sugarcane, where there appears to be a structural difference across states, with two distinct clusters of states observed. A dummy was used in this case for one of the two clusters (Andhra Pradesh, Karnataka and Maharashtra). The second problem arises with the pooled data on potato and onion. A dummy was used for one of the two crops, but this remained the only exception to the general finding (table 4.1) of positive and statistically significant coefficients for crop yield.

These significant coefficients in the regression result suggests that in the triennium chosen for anchoring ψ_{ij}, contiguity of years is of little relevance in the choice since they may depict different yield conditions. In studies related to agriculture it is usual to take an average of three contiguous years for any required estimate rather than a single year's value, because of exogenous climatic vagaries so prevalent in agriculture. In the next section, three-year clusters are formed from the sample period in terms of yield similarity, and the surplus parameter ψ is then computed from the average for the cluster.

Table 4.1

Regression Results

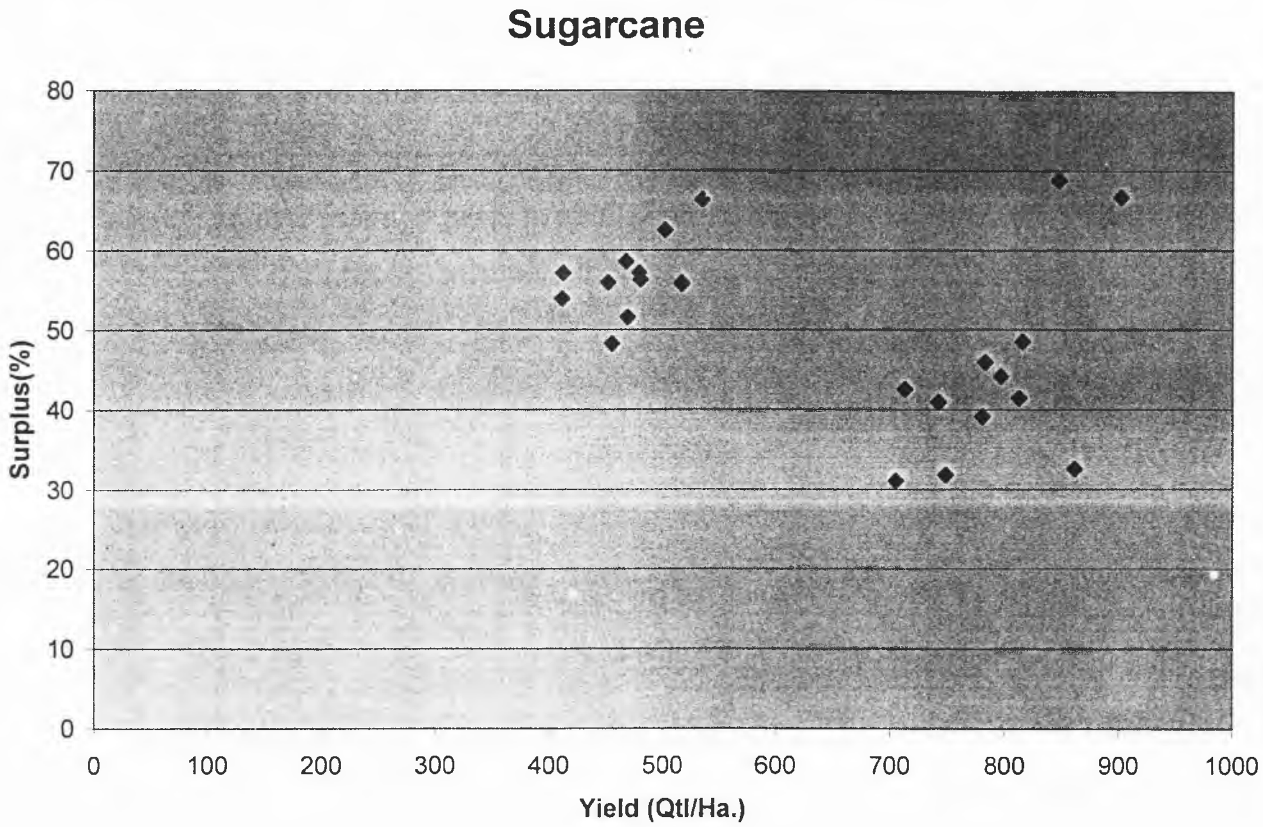
Dependent variable: Surplus (%) of total farm revenue over cost of cultivation

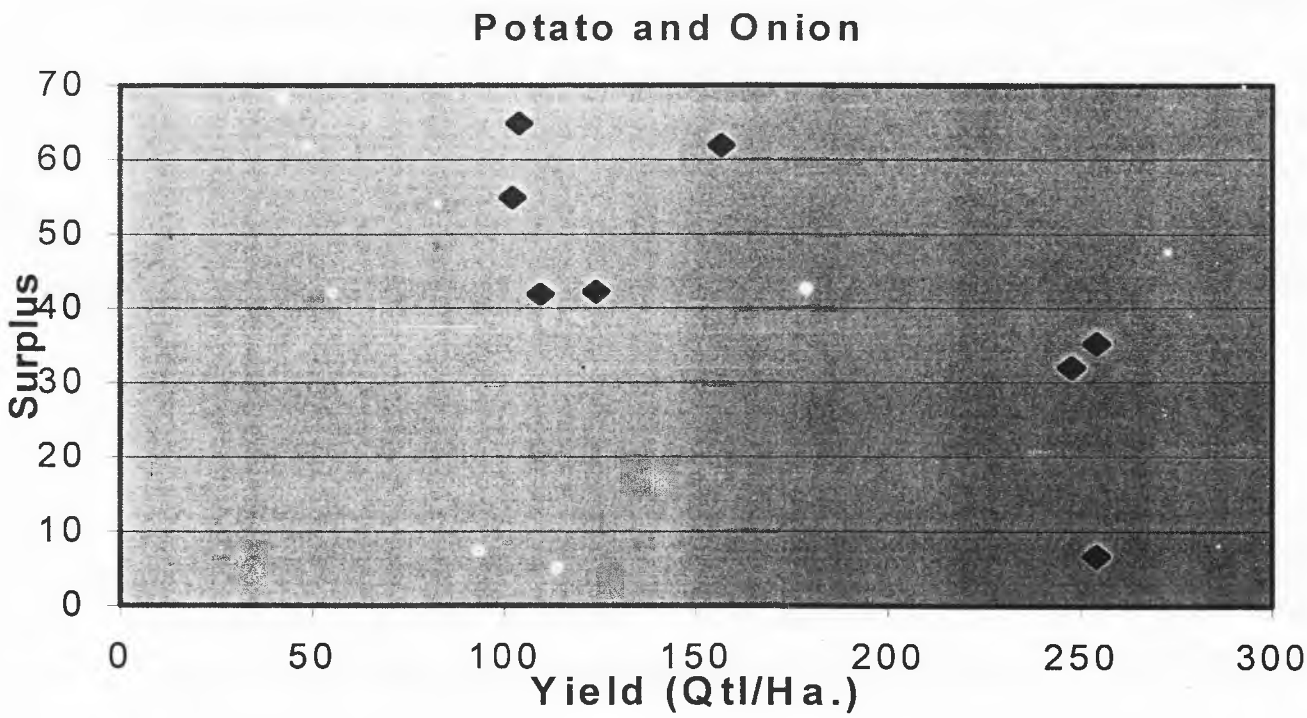
Crop	Paddy	Wheat	Groundnut	Rapeseed
Period	1990-91 to 1996-97	1990-91 to 1997-98	1990-91 to 1996-97	1990-91 to 1997-98
States	AP. HR, OR, PJ, UP, WB	GJ, HR, MP, PJ, RJ, UP	AP, GJ, MH, OR, TN	GJ, HR, MP, RJ, UP
No. of obs.	30	33	23	21
$\bar{R}^2$	11.1	38.6	27.6	55.7
Coeff. Of Yield (qtl/ha.)	0.264 (1.87)	0.563 (4.41)	3.414 (2.83)	3.276 (4.75)
Crop	**Cotton**	**Sugarcane**	**Potato and onion**	
Period	1990-91 to 1996-97	1990-91 to 1997-98	1990-91 to 1996-97	
States	AP, GJ, HR, MH, PJ, RJ, TN	AP, HR, KN, MH, UP	WB, MH	
No. of obs.	24	24	8	
$\bar{R}^2$	10.6	51.8	46.3	
Coeff. Of Yield (qtl/ha.)	2.242 (1.61)	0.109 (3.39)	0.062 (0.21)	

Source: Appendix table A4.3.

Notes: 1. Figures in parentheses are t-statistics.

2. For sugarcane there was an intercept dummy for AP, KN and MH.
3. Data on potato and onion were pooled, with an intercept dummy for onion.


Sugarcane
80
70
60
50
40
30
20
10
0
Surplus(%)
0
100
200
300
400
500
600
700
800
900
1000
Yield (Qtl/Ha.)


Potato and Onion
70
60
50
40
30
20
10
0
Surplus
0
50
100
150
200
250
300
Yield (Qtl/Ha.)

For any assessment year, there is a choice between using the anchored value of the parameter ψ_{ij}, or a parameter adjusted to the crop yield in the assessment year using the regression coefficients of table 4.1. Both methods are applied at state and district-level in subsequent sections of the paper.

5. THE SURPLUS PARAMETER AT ANCHORED YIELDS

The regressions reported in the last section show a clear relation between crop yield and the surplus of revenue over cost. A positive relation is substantiated in nearly all the cases. This then requires that the surplus parameter should be an average of observed surpluses across years characterised by yield similarity rather than time-contiguity, so as to be robust at the specified base yield.

Following convention, averages are taken across three years wherever possible two where not. For most crops, the triennium 1994-95, 1995-96 and 1996-97 is available and appropriate for inclusion as judged from the stability of the yield rate during the period. An exception is wheat in Punjab and a few other cases in 1996-97, when favourable weather conditions pushed up yields way above the adjoining years and helped to realise an extraordinarily low cost ratio.[6] To avoid an upward bias in the surplus estimator, this year was eliminated and replaced by the succeeding year. Appendix table A5.1 presents the years chosen as base and the corresponding yield levels and surplus ratios.

The average for the three years, which becomes thereby the anchor yield at which the surplus parameter will be prescribed, is presented in table 5.1, alongside the average yield for the same years from official (non-COC) crop yield data. There is a startling discrepancy between the two sources in some cases. Since the COC is the only possible source from which cost-revenue ratios can be

6 This was a good year nationally as well, with agricultural growth at 9.3 percent.

calculated, there is no option but to stay with it, but these discrepancies do highlight the need for adjusting the taxable surplus parameter to actual yields in any year, especially in the light of the regression results of section 4.

Table 5.1 also presents an estimate of the threshold yield for the same set of states and crops from the crop insurance scheme, for those states participating in the scheme. Even at the elevated anchor yields based on COC data, the threshold yield is never below one-third of the anchor yield.

To compare the implications of using the alternative specifications of cost, we present in appendix table A5.2 the average across the chosen years of the ratio of cost to revenue based on three different specifications; actual cost C2/R; C2adj/R which excludes rent on own land; and M3adj/R which adds on managerial input cost (see section 4). The last is the one recommended in the previous section, and used for the tax calculations.

Table 5.1

Crop Yields

q/ha

	Anchor yield 94-97 COC	**Average Yield 94-97 CMIE**	**Ratio anchor/ average**	**Threshold yield 1997-99**	**Ratio anchor/ threshold**
Paddy					
Andhra	46.63	37.96	1.23	31.10	1.50
Haryana	40.83	43.23	0.94	..	..
Orissa	27.56	18.97	1.45	10.37	2.66
Punjab	49.84	49.55	1.01	..	..
UP	30.87	28.15	1.10	24.54	1.26
West Bengal	33.02	31.50	1.05	26.99	1.22
Wheat					
Gujarat	26.16	21.17	1.24	21.54	1.21
Haryana	38.74	37.47	1.03	..	..
MP	18.06	16.95	1.07	13.44	1.34
Punjab	37.08	39.41	0.94	..	..

Table 5.1 (Contd...)

	Anchor yield 94-97 COC	Average Yield 94-97 CMIE	Ratio anchor/ Average	Threshold yield 1997-99	Ratio anchor/ threshold
Rajasthan	31.20	25.80	1.21	..	..
UP	29.47	24.27	1.21	22.52	1.31
Sugarcane					
Andhra	798.64	729.29	1.10	673.74	1.19
Haryana	502.76	380.79	1.32	..	..
Karnataka	874.63	909.05	0.96	730.35	1.20
Maharashtra	769.58	814.90	0.94	688.16	1.12
UP	483.81	617.47	0.78	540.40	0.90
Cotton					
Andhra	12.04	10.86	1.11	4.85	2.48
Gujarat	10.14	10.12	1.00	8.15	1.24
Haryana	12.57	14.51	0.87	..	..
Rajasthan	12.45	12.47	1.00	..	..
Maharashtra	7.10	5.76	1.23	2.54	2.80
Punjab	10.95	16.55	0.66	..	..
Tamil Nadu	12.67	9.17	1.38	..	..
Groundnut					
Andhra	8.80	9.60	0.92	5.20	1.69
Gujarat	9.60	12.12	0.79	8.06	1.19
Maharashtra	9.15	11.75	0.78	9.12	1.00
Orissa	12.10	9.83	1.23	7.77	1.56
Tamil Nadu	14.86	16.15	0.92	13.71	1.08
Rape-Mustardseed					
Gujarat	14.68	12.85	1.14	9.61	1.53
Haryana	13.75	13.73	1.00		
MP	7.98	7.70	1.04	5.94	1.34
Rajasthan	9.76	8.40	1.16		
UP	11.59	10.50	1.10	5.54	2.09

Source: Appendix 1 for threshold yield; table A5.1 for anchor yield, not for the period 1994-97 in some cases (notes to the table). Average yield reported from CMIE is from official data.

Across crops, the lowest cost to revenue ratio and hence *the highest* taxable surplus parameter, are found for sugarcane and, more surprisingly, rape/mustard seed and onion. The highest cost/revenue crop with the lowest taxable surplus is groundnut as expected. Paddy, wheat and cotton vary within the range 60-70 percent for cost (M3adj) as a share of revenue.

6. TAX REVENUE PER HECTARE AT ANCHORED YIELDS

In this section the values of ψ_{ij} developed in section 5 for the ith crop in the jth state will be used to compute the per hectare levy and total revenue for a specific year within the cluster, 1996-97, the most recent for which COC data are reported on nearly all states. The exceptions are sugarcane for Andhra Pradesh and Haryana and cotton for Haryana, for which the calculations are done with reference to 1995-96.

The surplus parameter ψ_{ij} so obtained using the clustered years as base can then be applied to any current year to obtain an estimate of the taxable surplus and thereby the levy admissible for any region as follows:

$$TR_{ijt} = Y_{ijt} \times P_{ijt}$$
$$L_{ijt} = r \times \psi_{ij} \times TR_{ijt}$$
$$R_{ijt} = L_{ijt} \times A_{ijt}$$

where

TR;Y;P	=	Total farm revenue per hectare; yield per hectare; price
i	=	crop
j	=	state/region
t	=	year
r	=	rate of levy on taxable surplus
L	=	absolute levy in Rs/hectare
R	=	Total tax revenue
A	=	Area (in hectares).

Appendix table A6.1 shows the calculations for 1996-97, using implicit prices derived from the COC data, and two rates of levy, 0.50 percent and 1 percent of taxable surplus.

Table 6.1 presents the summary results of the exercise with a 1 percent rate of levy on the taxable surplus. The range of values for ψ_{ij} is reduced to one for potato and onion, for the single state for which data were available in each case.

Table 6.1

Summary Table of Tax Potential (1996-97) Computed at Tax Rate 1%

	No. of states	ψ (%)	GCA m.ha.	Tax payable Rs/ha.	Total tax revenue (Rs cr)
Crops					
Paddy	6	31.4-41.1	22.9	38-87	136.16
Wheat	6	34.4-50.6	21.6	52-116	172.41
Sugarcane	5	34.9-67.8	3.2	121-428	65.09
Cotton	7	24.1-61.0	7.9	49-139	57.15
Groundnut	5	18.1-42.4	5.6	20-72	22.01
Rapeseed & Mustard	5	40.6-61.0	5.6	44-104	36.27
Potato	1	24.6	0.3	103	3.24
Onion	1	46.2	0.1	129	1.23
Total			67.2		493.56

Source: Statistical Abstracts of relevant states for Gross Cropped Area (GCA); for other calculations, tables A6.1 and A7.1.

Note: Where COC data for 1996-97 were not uniformly available (sugarcane in AP and HR, cotton in HR) levies per hectare were calculated from 1995-96 crop yields and prices and applied to GCA of 1996-97.

At roughly Rs 500 crore in aggregate across all crops for 1996-97, the crop-specific supplementary levy adds on 50 percent to the total collection from land revenue that year of Rs 1074 crores. If from this figure, the West Bengal cess on coal mines is excluded, the supplementary levy adds on 80 percent to the Rs 622 crores collected in 1996-97 from land revenue on agricultural land.

7. TAX REVENUE WITH ADJUSTED PARAMETER

The tax revenue for the selected crops in 1996-97 is computed in this section using the same procedure as outlined in Section 6 but with the surplus parameter adjusted to crop yield, using the coefficient of the yield term from the regression exercises of section 4, thus:

$$\Delta \psi_{ij} = \beta_i \, \Delta \, \text{Yield}_{ij}$$

where

β_i : Coefficient of adjustment of the surplus parameter for the i^{th} crop

Δ Yield_{ij} : Difference between current and anchored yield for the i^{th} crop in the j^{th} region.

The adjusted parameter for any change in yield rate around the anchored yield is given by:

$$\psi_{ij}^{a} = \psi_{ij}^{b} + \beta_i \, \Delta \, \text{Yield}_{ij} \qquad \text{..........} (7.1)$$

where

ψ_{ij}^{b} is the base or anchored parameter; ψ_{ij}^{a} is the adjusted parameter.

Remembering that the surplus parameter ψ was averaged over a three-year period that included 1996-97 in most cases, an adjustment for 1996-97 is called for merely to the extent that the yield that year differs from the average for 1994-97. The case for adjustment differs with the direction of adjustment. Higher yields than the anchored yield offer a chance for raising larger tax revenue via a higher surplus parameter. In the case of yield shortfalls, the surplus parameter built on the anchored yield may lead to an excessive levy. Two schemes of adjustment are possible.

Symmetric adjustment across yield changes around the clustered yield implies adjustment in accordance with equation 7.1 for all values of $\Delta\ \psi_{ij} > 0$.

Asymmetric adjustment provides reprieve for yield shortfalls alone, with no enhancement for higher yields, and is done only for yields below the anchored yield, thus:

$$\psi_{ij}^{a} = \psi_{ij}^{b} + \beta_i\ \Delta\ \text{Yield}_{ij} \quad \text{for } \Delta\ \text{Yield}_{ij} < 0$$

$$\psi_{ij}^{a} = \psi_{ij}^{b} \quad \text{for } \Delta\ \text{Yield}_{ij} > 0$$

Asymmetric adjustment effectively presumes the cluster yield to be a threshold beyond which the surplus stabilises.

As noted earlier, 1996-97 was a fairly good agricultural year in general and yield rates in most cases went up. This resulted is upward adjustments of ψ in a large number of cases for the symmetrical case although the impact on tax revenue shown in table 7.1 was negligible in most cases. Wheat shows the single largest positive impact of adjustment on tax revenue, as high as Rs 8.52 per hectare in Punjab, with total tax revenue going up by Rs 7 crores. Asymmetric adjustment as expected brings a decline in revenue. The final figures of aggregate tax revenue across the ohosen crops and states show only a roughly 3 percent difference between symmetric and asymmetric adjustment, and a fall of under one percent with asymmetric adjustment relative to the unadjusted levy.

The levy rates admissible for the two schemes are presented in Appendix table A7.1. The choice depends on the value attached to revenue potential as against equity concerns.

Table 7.1

Estimated Tax Revenue with Adjusted Parameters For 1996-97 at 1% Levy Rate

(Rs crore)

	Unadjusted	Adjusted	
		Symmetric	Asymmetric
Crop			
Paddy	136.16	138.03	135.71
Wheat	172.41	179.09	172.41
Sugarcane	65.09	64.41	63.51
Cotton	57.15	57.39	56.44
Groundnut	22.01	24.36	21.97
Rapeseed & Mustard	36.27	37.88	35.74
Potato	3.24	3.26	3.24
Onion	1.23	1.23	1.23
Total	493.56	505.64	490.25

Source: Table A7.1.

8. TAX POTENTIAL AT DISTRICT LEVEL

In this section, the levy rates per hectare are adjusted for within-state spatial dissimilarity of yields, for four selected states: Punjab, Rajasthan, Andhra Pradesh and West Bengal.

The year chosen is the most recent for which district level data on crop yields and acreages were available: for Andhra Pradesh and Rajasthan 1998-99; for West Bengal and Punjab, 1997-98. Farm harvest prices at state-level were available for Rajasthan and West Bengal.[7] Where farm harvest prices were not available, as in the case of Andhra and Punjab, wholesale prices were adjusted

[7] There may be a slight difference between market quotations of harvest prices, and the prices derived from COC, which are implicit prices reflecting the amounts actually received by the

down to yield an approximation to harvest prices, based on their proportional relation from the COC data for 1994-97.

The adjusted surplus parameter ψ_{ij}^{a} is obtained for each district on the basis of the base state-level parameter ψ_{ij}^{b} in the same way as discussed in section 7, for both symmetric and asymmetric adjustment. This parameter applied to district-level crop yield per hectare valued at the state-level price for the crop generates the levy per hectare in each district, which together with the district-level acreage under the crop generates the crop-specific revenue for the district. Appendix tables A8.1 to A8.4 present the district-specific details for both symmetric and asymmetric adjustment. Adding up across districts, we get an estimate of the total revenue that local governments can access from the selected crops in each state.

Summary results for the four states are presented in table 8.1, for asymmetric adjustment alone, along with the per hectare levy, and total revenue, had the adjustment been applied to the average state-level crop yield. The district-specific levy leads to no marked change in terms of aggregate revenue, but the range in terms of levy per hectare exhibits the enormous underlying variation in yield, and therefore the implicit unfairness in a uniform state-level levy.

Table 8.2 lists the districts in each state by descending order of total revenue aggregating across the crops, along with district-wise shares of total revenue. In each state, the district at the head of the list appropriates between 10-20 percent of total revenue. The lowest ranked districts have about one percent of total state revenue, which on average for these four states works out at Rs 40 lakhs. Rajasthan is the exception, where the revenue in the lowest ranked districts goes down to under Rs 20 lakhs. Even so, these are significant

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producers. Also the COC prices obtained from the ratio of value to physical yield includes the prices received for the by-products that result from cultivation of the main crop.

Table 8.1

Summary of Adjusted Levies at District Level

Crop	Farm harv price Rs/q.	Adjusted state-level			Adjusted district-level			
		ψ (%)	1% Levy (Rs/ha)	Tax rev (Rs cr)	ψ (%)	1% Levy (Rs/ha)	Tax rev (Rs cr)	No. dist. (80% rev.)
Andhra Pradesh: 1998-99								
Paddy	484	32	65	27.99	26-34	26-81	28.04	12
Groundnut	1309	18	26	5.10	14-18	14-55	5.03	6
Sugarcane	55	43	185	3.99	7-46	16-273	3.67	6
Cotton	1987	26	37	4.76	10-36	14-103	5.19	7
Total				41.84			41.93	
Punjab: 1997-98								
Paddy	446	41	95	21.75	39-41	74-110	21.56	9
Wheat	502	41	79	25.91	37-41	57-88	25.65	11
Cotton	1754	29	40	2.90	11-36	7- 77	2.99	4
Total				50.56			50.20	
Rajasthan: 1998-99								
Wheat	596	40	59	16.20	32-43	23-93	16.40	16
Cotton	1935	52	83	5.33	33-61	44-147	5.39	3
Rape-must	1250	45	54	12.53	30-45	19-76	12.15	16
Total				34.06			33.93	
West Bengal: 1997-98								
Paddy	494	36	59	34.85	31-36	26-78	34.28	10
Potato	391	22	180	5.10	17-25	97-243	5.15	6
Total				39.95			39.44	

Source: Agricultural Situation in India, August 2000, for farm harvest prices; tables A8.1-A8.4 for levies. Tax revenues calculated from GCA in states, sourced from District-wise Area and Production of Crops in India 1997-98 and 1998-99 or from State Statistical Abstracts.

Notes: Results are based on asymmetric adjustment, at both state and district level. The highest adjusted parameter at district-level can exceed the adjusted parameter at state-level, but not the unadjusted state-level parameter at the anchored yield (see table A6.1).

additions to revenue collected in these four states in 1997-98 on average per district, as reported by the report of the Eleventh Finance Commission, shown in table 8.3. Own revenue collected by panchayats, aggregating across all three levels, does not include land revenue which is collected by state governments. The additional revenue from the scheme proposed in this paper ranges between one-third in Andhra to double in West Bengal of average per district own revenue of panchayats in the four states in 1997-98.

Table 8.2

Share of Districts in State Revenue Aggregating Across Crops

Rank	District	Revenue (Rs cr)	Share (%)	District	Revenue (Rs cr)	Share (%)
	Punjab			**West Bengal**		
	Total	50.20	100.00	Total	39.44	100.00
1.	Sangrur	7.24	14.42	Midnapore	7.54	19.12
2.	Firozepur	6.59	13.13	Burdwan	5.89	14.93
3.	Amritsar	5.04	10.03	Bankura	3.48	8.83
4.	Ludhiana	4.70	9.36	Hooghly	3.28	8.31
5.	Patiala	4.27	8.51	Birbhum	2.83	7.17
6.	Bathinda	3.14	6.26	Murshidabad	2.48	6.29
7.	Gurdaspur	2.82	5.61	Nadia	2.06	5.24
8.	Moga	2.34	4.67	24-Parganas(N)	1.92	4.87
9.	Mansa	2.30	4.59	Purulia	1.56	3.96
10.	Jalandhar	2.29	4.56	24-Parganas(S)	1.56	3.95
11.	Muktsar	1.87	3.72	Malda	1.51	3.82
12.	Faridkot	1.59	3.16	Uttar Dinajpur	1.30	3.31
13.	Fatehgarh Sahib	1.57	3.12	Dakshin Dinajpur	1.15	2.91
14.	Kapurthala	1.45	2.89	Cooch Behar	1.08	2.75
15.	Hoshiarpur	1.22	2.43	Jalpaiguri	0.82	2.09
16.	Ropar	0.97	1.93	Howrah	0.80	2.02
17.	N.Shahar	0.80	1.60	Darjeeling	0.18	0.44

Table 8.2 (Contd...)

Rank	District	Revenue (Rs cr)	Share (%)	District	Revenue (Rs cr)	Share (%)
	Andhra Pradesh			**Rajasthan**		
	Total	41.93	100.00	Total	33.93	100.00
1.	West Godavari	4.34	10.34	Ganganagar	5.14	15.16
2.	Krishna	3.68	8.77	Hanumangarh	3.21	9.45
3.	Karimnagar	2.99	7.14	Alwar	2.76	8.12
4.	Guntur	2.83	6.76	Bharatpur	2.17	6.40
5.	East Godavari	2.77	6.62	Jaipur	1.54	4.53
6.	Warangal	2.77	6.61	Bundi	1.31	3.86
7.	Nalgonda	2.63	6.27	Kota	1.20	3.54
8.	Ananthapur	2.55	6.09	Dausa	1.17	3.46
9.	Chittoor	2.17	5.17	Jhunjhunu	1.16	3.41
10.	Nellore	1.95	4.66	Jalore	1.08	3.17
11.	Khammam	1.83	4.37	Nagaur	1.04	3.05
12.	Nizamabad	1.68	4.01	Tonk	1.03	3.04
13.	Kurnool	1.54	3.68	S.Madhopur	1.01	2.96
14.	Prakasam	1.46	3.48	Bikaner	0.88	2.59
15.	Medak	1.08	2.57	Jodhpur	0.87	2.57
16.	Srikakulam	1.02	2.44	Pali	0.79	2.34
17.	Mahbubnagar	0.98	2.33	Baran	0.79	2.33
18.	Vizianagaram	0.98	2.33	Sikar	0.78	2.31
19.	Cuddapah	0.97	2.30	Bhilwara	0.76	2.23
20.	Adilabad	0.85	2.03	Karoli	0.73	2.15
21.	Visakhapatnam	0.45	1.07	Dholpur	0.70	2.05
22.	Rangareddy	0.40	0.96	Chittorgarh	0.65	1.93
23.	Hyderabad	0.00	0.00	Sirohi	0.41	1.21
24.				Ajmer	0.40	1.19
25.				Banswara	0.40	1.18
26.				Udaipur	0.39	1.15

Table 8.2 (Contd...)

Rank	District	Revenue (Rs cr)	Share (%)	District	Revenue (Rs cr)	Share (%)
				Rajasthan		
27.				Jhalawar	0.34	0.99
28.				Jaisalmer	0.33	0.98
29.				Barmer	0.29	0.86
30.				Churu	0.29	0.85
31.				Dungarpur	0.18	0.52
32.				Rajsamand	0.14	0.43

Source: Calculated from tables A8.1 – A8.4.

Table 8.3

Panchayat Revenues

	Crop-specific levy		Own revenue (1997-98)		Additional rev. (%) per district
	Aggregate Rs cr.	Per district Rs cr.	Aggregate Rs cr.	Per district Rs cr.	
Andhra	41.93	1.82	137.80	5.99	30
Punjab	50.20	2.95	53.87	3.17	93
Rajasthan	33.93	1.06	31.25	0.98	108
West Bengal	39.44	2.32	19.56	1.15	201

Source: Crop-specific levy from table 8.1 for either 1997-98 or 1998-99. Report of the Eleventh Finance Commission for own revenue, 1997-98.

9. CONCLUSION

9.1 The principal objective of this paper has been to establish that it is indeed feasible to estimate region and crop specific taxable surplus parameters using published cost of cultivation (COC) data of the Ministry of Agriculture. These parameters ψ_{ij}, for the ith crop in the jth region, have been obtained after reconstituting the reported components of cost of cultivation. Since these data are available as state-level averages, not at farm-level, the crop-specific parameters can be disaggregated to the level of the state at best. However, the paper demonstrates that the state-level parameter can thereafter be applied to district-level yields to obtain district-specific levies per hectare.

9.2 Comparing the COC crop yield figures for the most recent triennium to crop yield estimates from standard official sources that go into the national accounts, the COC yields are higher, by factors ranging in most cases between 1.2 – 1.5, and upto 2.8 in one case. There are also a few cases where the ratio is less than one, where the COC figure is actually lower. Since there is no other source of cost of cultivation data, there is no option but to stay with the COC data, but the yield discrepancies are worrying.

9.3 A regression exercise performed by pooling all the observations for a crop across states, establishes that the taxable surplus is indeed a function of crop yield, with a positive slope coefficient. Based on this result, the taxable parameter ψ_{ij} was anchored for each state to a set of years selected for yield similarity rather than for contiguity in time. In most though not all cases, the selected years lie in the triennium 1994-97.

9.4 Because of apparent over-reporting of yields in COC data, the parameter ψ_{ij} itself is likely to be slightly overstated and may confer an upward bias on the levy rate. However, the regression coefficients provide a way to correct this by adjusting the parameter for the difference between actual yield and anchor yield in any assessment year. Asymmetric adjustment, for yield shortfalls below the anchor yield alone, does not differ substantially in terms of tax revenue potential from symmetric adjustment for yield variation in both directions relative to the anchor yield, or from what is obtainable from use of the unadjusted parameter. The levy rates per hectare do however change substantially with the use of adjusted parameters, especially across districts within a state.

9.5 In the end, the feasibility of the tax proposed rests on the acceptability of the levy rates per hectare. The state-level calculations were performed for eight selected field crops in a set of fourteen states overall. At a 1% rate of levy using asymmetrically adjusted parameters for the crop year 1996-97, the rates range between a low of Rs. 20 per hectare for groundnut in Maharashtra to Rs. 428 per hectare for sugarcane in Karnataka. For the two cereal crops, paddy and wheat, the rate ranges between Rs. 38 per hectare for paddy in Orissa and Rs. 116 per hectare for wheat in Haryana. These rates are *prima facie* reasonable, and feasible. Paddy and wheat yield 60 percent of the total tax potential from the levy, because of the large area sown to these two crops.

9.6 The total tax revenue as worked out with the limited coverage of this study in terms of crops and states is sizeable at nearly Rs 500 crores, amounting to 80% of the land revenue collected in the year 1996-97 from agricultural land at the national level.

9.7 The district-level levies were worked out only for a further reduced set of four states, Andhra Pradesh, Punjab, Rajasthan and West Bengal, for the most recent year, 1997-98 or 1998-99, subject to data availability. The rate range within a crop is widest in the case of sugarcane in Andhra Pradesh, from Rs. 16 per hectare for Visakhapatnam district, to Rs. 273 per hectare for Krishna district. The rate range is lowest for groundnut, also in Andhra, from Rs. 14 per hectare in Mahbubnagar, to Rs. 55 per hectare in Nizamabad.

9.8 The tax scheme is designed to be implemented at the Panchayat level. The paper demonstrates the feasibility of such a levy, using district level yield data as collected by State governments to obtain the levy rate per hectare. The crop-specific levy proposed in this paper can contribute additional revenue per district ranging from 30 percent of own revenue collections by panchayats in Andhra, as estimated by the Eleventh Finance Commission for 1997-98, to 201 percent for West Bengal. These percentage increases are relative to own revenue collected by panchayats, aggregating across all three tiers. Own revenue does not include land revenue, which is a State government levy, although the proceeds are often shared by state governments with Panchayats.

9.9 The crop specific tax levies proposed adjust for actual yield below anchor yields, but carry no exemption threshold yield. There is a crop insurance scheme now on offer in India, details of which are in an appendix. This scheme protects against area yield failure, at thresholds stipulated for each of several regions within a state. Panchayats will be free to exempt farmers facing idiosyncratic yield failure, using the same announced thresholds as under the crop insurance scheme.

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Appendices

CROP INSURANCE

GIC operates a crop insurance scheme in India on behalf of Central and State governments, starting 1 April 1985 as the Comprehensive Crop Insurance Scheme (CCIS). The scheme has undergone a few mutations over the years. What is described below is the National Agriculture Insurance Scheme (NAIS, alternatively known as the RKBY), which started in October 1999 with the Rabi season. It may soon metamorphose into an Income Guarantee Scheme, whose contours will follow those of the NAIS presently in place. The focus of the income guarantee scheme will be to protect farmers against both yield shortfalls and price volatility.

Crop insurance is classically an area where market failure arises, not so much because of information asymmetry, but on account of the fact that exogenous risk is correlated across individuals in a region (Duncan & Meyer 2000). This makes it impossible to reduce risk through pooling, unless diversification is possible across agricultural zones with non-synchronized exogenous influences.

In India, given the government monopoly in all areas of insurance until very recently, the issue of market failure in the context of competition does not arise. In accordance with the recommendations that follow from the theory, the coverage of the GIC scheme has steadily increased over the time, thus reducing risk within the pool. Also, given that exogenous catastrophes in Indian agriculture are not usually synchronised across regions, the chances of a commercially viable scheme being operated by a nation-wide company with minimal government subsidy are very promising.

1. **Coverage:** Crop coverage presently extends beyond food crops to include sugarcane, cotton, oil seeds and potato, and eventually will encompass all crops. Participation by farmers taking working capital crop production loans from banks is compulsory, with premia payable by farmers collected routinely through banks. A 50 percent premium subsidy is paid only to small and medium farmers (and is scheduled to be phased out over five years). Non-loanee farmers opting for inclusion under the scheme are also required to pay through banks. In this manner the administrative task of premium collection has been satisfactorily resolved. Claim payments in turn are made through banks.

2. **Area basis:** The scheme is area-based, with the defined area as determined by the relevant state government subject to a requisite minimum number of crop-cutting experiments (CCE)[8] to assess crop yields. There is a provision for localised catastrophes such as landslides or hailstorms afflicting a sub-area within any delineated region, but no provision for idiosyncratic catastrophes afflicting a single farmer.

3. **Crop yield data:** All yield data are obtained from the crop cutting data of the NSSO. There is also a State government "annawari" revenue department assessment of yields relative to the potential, based purely on visual assessment, which is an alternative source of loss estimation, but is not used, except possibly as a supplementary source of information on localised catastrophes.

4. **Two concepts of average crop yield:** For each crop, a moving ten-year average of physical yield is used to determine yield volatility, obtained from the coefficient of variation (c.v.) around the ten-year mean. This ten-yearly average is used only to classify crops by the range in terms of c.v.

in which they fall. There is another moving average, over a five or three year period varying by crop, which is referred to as the "average yield".

5. **Risk classification:** Based on the c.v., three risk categories are defined as follows:

CV = 0 - 15% Low Risk (LR)

CV = 16 - 30% Medium Risk (MR)

CV > 30% High Risk (HR)

The state/UT as a whole is classified according to the modal category of risk to which the notified areas in the state belong.

6. **Indemnity:** The volatility classification from the ten-year moving average is then used to set the indemnity level for the different crops, which determines the amount of compensation payable. There are three indemnity rates: 60, 80 and 90 percent,[9] corresponding to HR, MR, and LR categories respectively. Indemnities (ID) are thus inversely related to the coefficient of variation. Higher volatility goes with lower rates of indemnity. The ID is fixed at the modal category level which means the <u>indemnity level for any crop is state-specific</u>. However, farmer can opt for a higher ID on payment of higher premiums at actuarial rates.

7. **Threshold yield:** The ID applied to the average yield, obtained over a three or five year period, determines what is termed the threshold yield (TY) for each crop, specified in physical units. The threshold yield, like the average yield, is thus region-specific.

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8 The number of CCEs undertaken per unit insurance area per notified crop are as follows: (1) Taluka, Tehsil, Block: 16; (2) Mandal, Phirka, or other smaller unit area comprising 8-10 villages: 10; (3) Gram Panchayat comprising 4-5 villages: 8.

9 A fourth rate of 70 percent seems not to apply at all.

8. **Shortfall:** The Actual Yield (Y) per hectare based on CCE data must be furnished by the State or UT Government by a specified cutoff date. If this falls short of TY, all insured farmers of the specified crop and area are deemed to have suffered a shortfall, quantified in percentage terms, thus: ((TY – Y)/TY) X 100, where TY is the area-specific threshold yield, and Y is the area-specific actual yield. The percent shortfall extends to all farmers in the area.

9. **Sum insured:** The minimum amount of sum insured (SI) is the amount of loan disbursed in case of loanee farmers and this is compulsory. The SI may at the option of insured farmer extend upto the value of the TY at the minimum support price (MSP), where available, or at the buying price of the State Marketing Board, where not. There is also an optional provision for additional insurance upto a maximum of 150 percent of the value of average yield (AY). <u>The sum insured in value terms is thus farmer-specific.</u> [10]

10. **Premia:** Premia are presently determined at a flat, non-actuarial rate of the sum insured, such as 2.5 percent for kharif paddy and 1.5 percent for wheat, with higher rates applicable to additional insurance above the threshold yield. There is a parallel calculation of actuarial rates, which are applied in case they fall below the prescribed flat rates. It is expected that a transition to actuarial rates will be made in 5 years time. GIC pays out claims upto premia received and the (State) government picks up the rest.

11. **Claims Payable:** The claim payable to farmers is obtained from the percentage shortfall, if any, of the actual yield in a particular season

relative to the threshold yield, applied to the sum insured. What is important is that all farmers in a region are entitled to a uniform percent shortfall, with the implicit assumption that all farmers are equally affected by any exogenous catastrophe.

12. **Income guarantee scheme:** The contours of the scheme, which protects against both yield and price volatility, will be essentially the same as that of the NAIS, except that a ten-year average will be taken of the minimum support price as well, which when applied to the ten-year average yield will provide the ten-year income average, against which the income volatility classification will be done. Eventually, the entire structure of procurement is to be replaced by the income guarantee scheme. Thus, there will be no announced MSP, but the mechanism for determination of the MSP will continue to remain in place, and will be applied to the current actual yield, to obtain current threshold income. Preliminary calculations suggests that the cost of the income guarantee scheme will be lower than that of the present yield based scheme, because of compensating price movements in years of yield failure.

13. **An exercise for 2000-01**: Table AI.1 constructs state-level threshold crop yields for the years 1997-98 and 1998-99, applying the indemnity rates fixed by GIC for 2000-01 (threshold yields are stipulated for the crop insurance scheme only at the area unit of operational relevance). Where indemnity rates vary by season or irrigation regime, the rate corresponding to the dominant (main) category is applied. Threshold yields are not computed for Punjab, Haryana and Rajasthan, which do not yet participate in the crop insurance scheme. Tamil Nadu does participate but did not notify cotton in the year considered. West Bengal also did not notify

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[10] Prior to the NAIS, the sum insured was set equal to the scale of finance as determined by the banks, which in turn is a function of cost of cultivation data as obtained from the COC, after exclusion of imputed inputs.

paddy for aman and aus (main), but the indemnity rate under the old CCIS Scheme was 1998-99 used as a substitute.

Table AI.1

	Indemnity rate (%) 2000-01		Average yield (q/ha) 1997-99	Threshold yield (q/ha) 1997-99	Anchor yield (q/ha) 1994-97	Ratio anchor/ av. 97-99
	Main	Other				
Paddy						
AP	80	80	38.87	31.10	46.63	1.20
HR	Not participating		37.79	..	40.83	1.08
OR	80	80	12.97	10.37	27.56	2.13
PJ	Not participating		49.62	..	49.84	1.00
UP	80	Not notified	30.68	24.54	30.87	1.01
WB	80	90	33.74	26.99	33.02	0.98
Wheat						
GJ	90	80	23.94	21.54	26.16	1.09
HR	Not participating		37.88	..	38.74	1.02
MP	80	80	16.81	13.44	18.06	1.07
PJ	Not participating		40.93	..	37.08	0.91
RJ	Not participating		24.94	..	31.20	1.25
UP	90		25.02	22.52	29.47	1.18
Sugarcane						
AP	90		748.60	673.74	798.64	1.07
HR	Not participating		541.16	..	502.76	0.93
KR	80		912.94	730.35	874.63	0.96
MH	80		860.20	688.16	769.58	0.89
UP	90		600.45	540.40	483.81	0.81
Cotton						
AP	60		8.09	4.85	12.04	1.49
GJ	60		13.59	8.15	10.14	0.75
HR	Not participating		9.95	..	12.57	1.26
RJ	Not participating		8.26	..	12.45	1.51
MH	60		4.23	2.54	7.10	1.68
PJ	Not participating		7.19	..	10.95	1.52
TN	Not notified		10.22	..	12.67	1.24
Groundnut						
AP	60		8.67	5.20	8.80	1.01
GJ	60		13.43	8.06	9.60	0.72
MH	80		11.40	9.12	9.15	0.80
OR	80		9.71	7.77	12.10	1.25
TN	80		17.14	13.71	14.86	0.87

Table AI.1 (Contd..)

	Indemnity rate (%) 2000-01		Average yield (q/ha) 1997-99	Threshold yield (q/ha) 1997-99	Anchor yield (q/ha) 1994-97	Ratio anchor/ av. 97-99
	Main	Other				
Rape-mustard seed						
GJ	80	..	12.02	9.61	14.68	1.22
HR	Not participating		9.49	..	13.75	1.45
MP	80	..	7.43	5.94	7.98	1.07
RJ	Not participating		8.45	..	9.76	1.16
UP	80	..	6.93	5.54	11.59	1.67

Source: i. Indemnity rates from GIC.

ii. Average yield for 1997-99 from DES, Min. of Agriculture, GOI where available; CMIE for sugarcane (Karnataka 1998-99 and Maharashtra 1998-99), cotton (Maharashtra 1998-99), groundnut (Maharashtra 1998-99), rape-mustard (Haryana 1998-99); groundnut (Andhra Pradesh 1998-99) from AP Statistical Abstract.

Notes: 1. "Not notified" is for participating states which did not notify a crop for a particular season.

2. Multiple indemnity rates distinguish between irrigated/unirrigated for wheat, or season (main and secondary) for other crops.

3. The threshold yield is obtained by applying the indemnity rate provided by GIC to the two-year average yield at state-level.

TABLES

Table A3.1
Value of Output (Rs/ha) of Crops as Average of Period 1994-95 to 1996-97

		Paddy				**Wheat**				**Maize**	
State		Value	Years	State		Value	Years	State		Value	Years
AP	*	20291	All	HR	*	19129	All				
PJ	*	19310	All	RJ	*	18867	All	AP		8966	All
HR	*	18315	1994,1996	PJ	*	18656	All	RJ		8375	1995,1996
WB	*	16262	All	UP	*	16809	1995,1996	UP		6311	1996
UP	*	14560	1996	GJ	*	16658	1995,1996	MP		4695	All
OR	*	11625	All	MP	*	10887	All				
MP		9913	All	WB		9190	1994				
AM		8321	All	HP		7435	1994,1995				

Pulses

		Gram				**Urad**	
State		Value	Years	State		Value	Years
UP		11245	1995,1996				
				AP		9632	All
HR		9056	All	TN		8880	1994
MP		9010	All	UP		5998	1996
RJ		7496	All	MH		5756	All
				MP		5694	All
				OR		5681	All

Oilseeds

		Groundnut				**Soybean**				**Rape&Mustard**	
State		Value	Years	State		Value	Years	State		Value	Years
TN	*	14330	1994,1995	MP		10082	All	GJ	*	15036	All
OR	*	14223	All					HR	*	14359	All
GJ	*	13770	All	RJ		9317	All	UP	*	13814	1995,1996
MH	*	13403	All					RJ	*	12514	All
AP	*	10494	All					MP	*	10366	1994,1996
								PJ		8730	All
								AM		5232	All

Commercial anJ horticultural crops

		Sugarcane				**Cotton**				**Potato**				**Onion**	
State		value	Years	State		Value	Years	State		Value	Years	State		Value	Years
TN		63262	1994	HR	*	24377	1994,1995	WB	*	44470	All	MH	*	29539	All
KN	*	60924	1994,1996	AP	*	22427	1994,1996								
AP	*	46181	1994,1995	RJ	*	21509	All								
MH	*	40261	All	TN	*	21462	1994,1996								
HR	*	39991	1995	PJ	*	20862	All								
UP	*	31704	All	GJ	*	17404	1996								
				MH	*	13895	All								
				MP		11008	1995								

Source: Govt. of India, <u>Cost of Cultivation of Principal Crops in India</u>, February 200.

Notes : i. All : 3 years covering the whole period.
ii. * : Selected case for study.

Table A4.1

Components of Cost

	Paid-out costs	Imputed costs
1.	Hired labour (human, animal and machinery)	Family labour
2.	Maintenance expenses of owned animals	Managerial input of the farmer
3.	Expenses on material inputs e.g.,seeds, fertilisers, manures, pesticides, irrigation	Rent on owned land
4.	Depreciation on implements and farm buildings	Interest on owned capital
5.	Land revenue	Owned animal labour
6.	Rent paid for leased in land	Owned machinery charges
7.		Implements
8.		Farm produced manure

Source: Ibid.

Table A4.2

Imputation Procedure for Computing Cost of Cultivation

	Imputed Costs	Imputation
1.	Family labour	On the basis of statutory wage rate or the market rate whichever is higher
2.	Managerial input of the farmer	10 percent of total cost C2*
3.	Rent on owned land	Estimated on the basis of prevailing rents in the village for identical type of land or as reported by the sample farmers, subject to the ceiling of fair rents given in land legislation of the concerned state.
4.	Interest on owned fixed capital	Interest on present value of fixed assets charged at the rate of 10% per annum.
5.	Owned animal labour	On the basis of maintenance cost including cost of fodder, concentrates depreciation and upkeep.
6.	Owned machinery charges	On the basis of maintenance cost of farm machinery which include diesel, electricity, repair, depreciation and other expenses.
7.	Implements	Depreciation and charges on account of minor repairs
8.	Farm produced manure	Evaluated at rates prevailing in the village.
9.	Interest on working capital	Interest charged at the rate of 12.5% per annum for the working capital for half the period of crop.
10.	Kind payments	Evaluated at prices prevalent in the village at the time such payments are made.
11.	Main and by-products	Imputed on the basis of post-harvest prices prevailing in selected villages.

Source: Ibid.

Table A4.3

Detailed Regression Results

States	Years Data pooled	Observa-tions	Parameters		Dummy	R^2
			Intercept	Yield		
Paddy		30	26.97 (7.38)	0.264 (.141)	-	11.1
AP	1990-91, 1994-97					
HR	1990-93, 1994-95, 1996-97					
OR	1990-93, 1994-97					
PJ	1990-97					
UP	1990-93, 1996-97					
WB	1991-92, 1994-97					
Wheat		33	25.9 (5.97)	0.563 (.128)	-	38.6
GJ	1992-94, 1995-97					
HR	1990-93, 1994-98					
MP	1990-93, 1994-98					
PJ	1990-93, 1994-98					
RJ	1992-93, 1994-98					
UP	1990-91, 1995-97					
Groundnut		23	-2.9 (14.33)	3.414 (1.21)	-	27.6
AP	1990-91, 1992-93, 1994-97					
GJ	1992-97					
MH	1990-91, 1992-93, 1994-97					
OR	1990-93, 1994-97					
TN	1994-95, 1996-97					
Rapeseed & Mustard		20	13.67 (8.1)	3.276 (.689)	-	55.7
GJ	1994-97					
HR	1990-93, 1994-98					
MP	1994-95, 1996-98					
RJ	1992-93, 1994-98					
UP	1995-97					
Cotton		24	18 (15.04)	2.24 (1.39)	-	10.6
AP	1994-95, 1996-97					
GJ	1992-94, 1996-97					
HR	1990-91, 1992-93, 1994-96					
RJ	1994-97					
MH	1994-97					
PJ	1990-97					
TN	1994-95, 1996-97					

Table A4.3 (Contd...)

States	Years Data pooled	Observations	Parameters: Intercept	Parameters: Yield	Dummy	R^2
Sugarcane		24	4.82 (15.4)	0.109 (.032)	-46.69 (10.66)	56
AP	1990-91, 1992-93, 1994-96					
HR	1990-91, 1992-93, 1995-96, 1997-98					
KR	1994-95, 1996-97					
MH	1990-91, 1992-93, 1994-98					
UP	1990-98					
Onion & Potato		8	9.04 (76.3)	0.062 .30)	36.66 (41.2)	46.3
WB	1994-97					
Onion						
MH	1990-91, 1992-93, 1994-97					

Table A5.1

Physical Yield and Surplus for the Clustered Years

Year	Yield (Qtl./hectare)			Surplus (1-M3adj/R)%			Years clustered		
	1	2	3	1	2	3	1	2	3
Paddy									
AP	47.73	45.12	47.04	34.90	32.43	31.48	1994-95	1995-96	1996-97
HR	38.21	43.44		29.20	33.56		1994-95	1996-97	
OR	30.27	28.23	24.18	37.30	35.44	29.05	1994-95	1995-96	1996-97
PJ	51.84	46.03	51.64	44.96	36.87	41.58	1994-95	1995-96	1996-97
UP	29.75	28.85	34.02	29.26	24.94	41.00	1991-92	1992-93	1996-97
WB	33.53	28.33	37.20	39.54	34.94	32.05	1994-95	1995-96	1996-97
Wheat									
GJ	28.28	24.99	25.22	36.52	33.84	32.79	1992-93	1993-94	1995-96
HR	38.85	40.80	36.57	50.24	51.26	50.17	1995-96	1996-97	1997-98
MP	19.38	18.09	16.70	42.07	42.88	34.91	1995-96	1996-97	1997-98
PJ	39.41	36.06	35.78	43.59	32.94	45.25	1994-95	1995-96	1997-98
RJ	31.05	32.06	30.50	46.78	43.92	38.59	1995-96	1996-97	1997-98
UP	26.43	29.55	32.43	31.99	36.58	47.24	1990-91	1995-96	1996-97
Groundnut									
AP	6.92	10.45	9.03	7.42	29.58	17.28	1994-95	1995-96	1996-97
GJ	7.00	10.46	11.33	37.54	41.97	45.08	1992-93	1994-95	1996-97
MH	8.73	9.57		10.24	19.73		1994-95	1996-97	
OR	12.93	12.13	11.25	46.89	45.69	34.61	1994-95	1995-96	1996-97
TN	14.46	15.26		18.04	18.53		1994-95	1996-97	

Table A5.1 (Contd....)

Year	Yield (Qtl./hectare)			Surplus (1-M3adj/R)%			Years clustered		
	1	2	3	1	2	3	1	2	3
Rapeseed and Mustard seed									
GJ	14.87	12.87	16.30	58.86	48.25	52.43	1994-95	1995-96	1996-97
HR	12.81	12.90	15.54	63.55	57.55	61.85	1994-95	1995-96	1996-97
MP	8.89	8.56	6.49	48.49	45.64	27.76	1994-95	1996-97	1997-98
RJ	11.43	10.78	7.08	51.00	48.25	36.77	1995-96	1996-97	1997-98
UP	12.60	10.57		59.88	53.44		1995-96	1996-97	
Sugarcane									
AP	796.88	783.04	816.01	44.20	45.96	48.57	1992-93	1994-95	1995-96
HR	455.82	535.32	517.15	48.24	66.36	55.92	1992-93	1995-96	1997-98
KR	847.13	902.13		68.83	66.76		1994-95	1996-97	
MH	860.89	705.53	742.33	32.60	31.10	40.95	1995-96	1996-97	1997-98
UP	469.51	479.51	502.40	51.58	57.17	62.53	1995-96	1996-97	1997-98
Cotton									
AP	11.12	12.95		54.59	18.34		1994-95	1996-97	
GJ	12.31	8.60	9.50	30.15	47.49	37.91	1992-93	1993-94	1996-97
HR	12.03	13.33	12.36	48.83	64.00	62.05	1992-93	1994-95	1995-97
RJ	11.08	13.99	12.27	59.25	69.70	54.18	1994-95	1995-96	1996-97
MH	7.31	6.38	7.62	52.96	32.37	24.98	1994-95	1995-96	1996-97
PJ	11.92	10.00	10.93	53.84	32.86	20.34	1994-95	1995-96	1996-97
TN	14.36	10.98		32.38	15.84		1994-95	1996-97	
Potato									
WB	247.56	253.96	254.08	31.62	35.35	6.74	1994-95	1995-96	1996-97
Onion									
MH	123.92	102.18	109.46	42.02	54.90	41.84	1994-95	1995-96	1996-97

Source: Ibid.

Table A5.2

Cost-revenue Ratios Under Different Specifications

State	C2/R	C2adj/R	M3adj/R
Paddy			
AP	92.95	63.92	67.06
HR	94.47	66.08	68.62
OR	84.57	63.05	66.07
PJ	84.17	57.22	58.86
UP	85.29	65.78	68.27
WB	85.66	61.23	64.49
Wheat			
GJ	80.41	63.86	65.62
HR	74.09	48.05	49.44
MP	83.50	58.50	60.05
PJ	84.58	57.93	59.40
RJ	69.72	55.03	56.90
UP	80.77	59.92	61.40
Sugarcane			
AP	80.55	51.14	53.76
HR	68.24	41.14	43.16
KR	52.25	30.90	32.21
MH	79.37	62.70	65.12
UP	65.75	40.99	42.91
Cotton			
AP	88.56	61.31	63.54
GJ	75.94	59.37	61.48
HR	58.66	39.60	41.71
RJ	53.36	37.38	38.96

Table A5.2 (Contd...)

State	C2/R	C2adj/R	M3adj/R
MH	77.63	60.96	63.23
PJ	88.62	61.87	64.32
TN	94.94	72.00	75.89
Groundnut			
AP	108.36	79.12	81.91
Guj	73.48	56.88	58.47
Maha	98.50	81.83	85.01
Oris	80.16	55.20	57.60
TN	104.57	78.67	81.71
Rapeseed and Mustard seed			
GUJ	61.94	45.52	46.82
HRY	65.82	37.83	39.02
MP	82.45	57.93	59.37
RAJ	68.36	52.68	54.66
UP	67.95	42.03	43.34
Potato			
WB	97.64	73.14	75.43
Onion			
MH	68.49	51.82	53.75

Source: Ibid.

Note: C2/R is actual total cost incurred divided by total value of output.

Table A6.1

Crop-Specific Levy Per Hectare: 1996-97

State	Yield qtl/ha.	Price Rs/qtl	Revenue Rs/ha.	ψ (%)	Levy rate: Surplus Rs/ha	Levy rate: 0.5% Rs/ha.	Levy rate: 1.0% Rs/ha.
Paddy							
AP	47.04	469.85	22101.55	32.94	7279.80	36.40	72.80
HR	43.44	461.78	20059.60	31.38	6294.82	31.47	62.95
OR	24.18	470.80	11383.91	33.93	3862.56	19.31	38.63
PJ	51.64	409.72	21157.74	41.14	8703.89	43.52	87.04
UP	34.02	427.98	14559.73	31.73	4620.50	23.10	46.21
WB	37.20	513.15	19089.31	35.51	6779.10	33.90	67.79
Wheat							
GJ	28.85	671.46	19371.48	34.38	6660.00	33.30	66.60
HR	40.80	560.77	22879.31	50.56	11567.25	57.84	115.67
MP	18.09	723.02	13079.43	39.95	5225.80	26.13	52.26
PJ	43.48	544.24	23663.39	40.60	9606.38	48.03	96.06
RJ	32.06	675.81	21666.42	43.10	9337.57	46.69	93.38
UP	32.43	606.71	19675.61	38.60	7595.59	37.98	75.96
Sugarcane							
AP	816.01	60.69	49527.64	46.24	22903.92	114.52	229.04
HR	535.32	74.70	39991.01	56.84	22730.58	113.65	227.31
KR	902.13	70.02	63170.31	67.79	42825.45	214.13	428.25
MH	705.53	49.28	34765.42	34.88	12127.43	60.64	121.27
UP	479.51	68.97	33073.19	57.09	18882.27	94.41	188.82

Table A6.1 (Contd.....)

State	Yield	Price	Revenue	ψ	Levy rate		
	qtl/ha.	Rs/qtl	Rs/ha.	(%)	Surplus Rs/ha	0.5% Rs/ha.	1.0% Rs/ha.
Cotton							
AP	12.95	1709.26	22134.92	36.46	8071.05	40.36	80.71
GJ	9.50	1831.98	17403.84	38.52	6703.52	33.52	67.04
HR	12.36	1919.83	23729.07	58.29	13832.53	69.16	138.33
RJ	12.27	1731.89	21250.29	61.04	12971.94	64.86	129.72
MH	7.62	1780.52	13567.60	36.77	4989.00	24.94	49.89
PJ	10.93	1662.19	18167.79	35.68	6482.82	32.41	64.83
TN	10.98	1950.92	21421.11	24.11	5164.71	25.82	51.65
Groundnut							
AP	9.03	1238.96	11187.85	18.09	2024.31	10.12	20.24
GJ	11.33	1525.42	17282.98	41.53	7177.70	35.89	71.78
MH	9.57	1427.99	13665.90	14.99	2048.04	10.24	20.48
OR	11.25	1158.50	13033.15	42.40	5525.63	27.63	55.26
TN	15.26	1064.46	16243.66	18.29	2970.32	14.85	29.70
Rape & Mustard							
GJ	16.30	1027.73	16751.94	53.18	8908.70	44.54	89.09
HR	15.54	1097.21	17050.65	60.98	10397.96	51.99	103.98
MP	8.56	1280.50	10961.07	40.63	4453.90	22.27	44.54
RJ	10.78	1103.30	11893.55	45.34	5392.66	26.96	53.93
UP	10.57	1257.59	13292.70	56.66	7531.17	37.66	75.31
Potato							
WB	254.08	165.10	41949.51	24.57	10307.17	51.54	103.07
Onion							
MH	109.46	255.21	27935.13	46.25	12921.02	64.61	129.21

Source: Ibid.

Table A7.1

Tax Revenue with Adjusted Surplus Parameter (1996-97; 1% Levy)

State	Anchor yield Qtl/ha.	Current yield Qtl/ha.	Adjusted ψ (%)	Levy			Tax Revenue		
				Unad-justed (Rs/ha)	Adjusted symmetric (Rs/ha)	Adjusted asymmetric (Rs/ha.)	Unad-justed (Rs cr.)	Adjusted symmetric (Rs cr.)	Adjusted asymmetric (Rs cr.)
Paddy									
AP	46.63	47.04	33.05	72.80	73.04	72.80	29.91	30.01	29.91
HR	40.83	43.44	32.07	62.95	64.33	62.95	5.23	5.35	5.23
OR	27.56	24.18	33.04	38.63	37.61	37.61	17.26	16.81	16.81
PJ	49.84	51.64	41.61	87.04	88.05	87.04	18.79	19.01	18.79
UP	30.87	34.02	32.57	46.21	47.41	46.21	25.64	26.31	25.64
WB	33.02	37.20	36.62	67.79	69.90	67.79	39.32	40.54	39.32
Wheat									
GJ	26.16	28.85	35.89	66.60	69.53	66.60	3.87	4.04	3.87
HR	38.74	40.80	51.72	115.67	118.33	115.67	23.33	23.87	23.33
MP	18.06	18.09	39.97	52.26	52.28	52.26	22.61	22.62	22.61
PJ	37.08	43.48	44.20	96.06	104.59	96.06	31.02	33.77	31.02
RJ	31.20	32.06	43.58	93.38	94.42	93.38	23.10	23.36	23.10
UP	29.47	32.43	40.27	75.96	79.23	75.96	68.47	71.42	68.47
Groundnut									
AP	8.80	9.03	18.88	20.24	21.12	20.24	4.45	4.64	4.45
GJ	9.60	11.33	47.45	71.78	82.00	71.78	13.17	15.05	13.17
MH	9.15	9.57	16.42	20.48	22.44	20.48	1.18	1.29	1.18
OR	12.10	11.25	39.48	55.26	51.46	51.46	0.53	0.50	0.50
TN	14.86	15.26	19.65	29.70	31.92	29.70	2.68	2.88	2.68

Table A.7.1 (Contd..)

State	Anchor yield Qtl/ha.	Current yield Qtl/ha.	Adjusted ψ (%)	Levy			Tax Revenue		
				Unadjusted (Rs/ha)	Adjusted symmetric (Rs/ha)	Adjusted asymmetric (Rs/ha.)	Unad-justed (Rs cr.)	Adjusted symmetric (Rs cr.)	Adjusted asymmetric (Rs cr.)
Rapeseed and Mustard seed									
GJ	14.68	16.30	58.49	89.09	97.98	89.09	3.07	3.38	3.07
HR	13.75	15.54	66.85	103.98	113.98	103.98	6.37	6.99	6.37
MP	7.98	8.56	42.53	44.54	46.62	44.54	3.27	3.43	3.27
RJ	9.76	10.78	48.67	53.93	57.89	53.93	14.53	15.60	14.53
UP	11.59	10.57	53.33	75.31	70.89	70.89	9.03	8.50	8.50
Sugarcane									
AP	798.64	816.01	48.14	229.04	238.41	229.04	4.56	4.74	4.56
HR	502.76	535.32	60.39	227.31	241.50	227.31	3.71	3.94	3.71
KR	874.63	902.13	70.79	428.25	447.19	428.25	10.90	11.38	10.90
MH	769.58	705.53	27.90	121.27	97.00	97.00	6.26	5.01	5.01
UP	483.81	479.51	56.62	188.82	187.27	187.27	39.66	39.34	39.34
Cotton									
AP	12.04	12.95	38.51	80.71	85.25	80.71	8.19	8.65	8.19
GJ	10.14	9.50	37.09	67.04	64.55	64.55	9.95	9.58	9.58
HR	12.57	12.36	57.82	138.33	137.19	137.19	9.02	8.94	8.94
RJ	12.45	12.27	60.65	129.72	128.88	128.88	8.49	8.43	8.43
MH	7.10	7.62	37.93	49.89	51.46	49.89	15.39	15.87	15.39
PJ	10.95	10.93	35.64	64.83	64.75	64.75	4.81	4.80	4.80
TN	12.67	10.98	20.32	51.65	43.53	43.53	1.30	1.10	1.10

Table A.7.1 (Contd..)

State	Anchor yield Qtl/ha.	Current yield Qtl/ha.	Adjusted ψ (%)	Levy			Tax Revenue		
				Unadjusted (Rs/ha)	Adjusted symmetric (Rs/ha)	Adjusted asymmetric (Rs/ha.)	Unad-justed (Rs cr.)	Adjusted symmetric (Rs cr.)	Adjusted asymmetric (Rs cr.)
Potato									
WB	251.87	254.08	24.71	103.07	103.65	103.07	3.24	3.26	3.24
Onion									
MH	111.85	109.46	46.11	129.21	128.80	128.80	1.23	1.23	1.23
Total							**493.56**	**505.64**	**490.25**

Source: Ibid. for anchor and current yield. For (unreported) figures of gross cropped area per hectare underlying the tax revenue estimates, CMIE, Agriculture November 2000.

Table A8.1

Estimated Tax Revenue at District Level: Andhra Pradesh 1998-99

S. No.	Districts	Paddy (anchor yield: 46.63 qtl/ha)			Sugarcane (anchor yield: 798.6 qtl./ha)		
		Yield (qtl/ha)	Sym. Levy (Rs/ha)	Asym. levy (Rs/ha)	Yield (qtl/ha)	Sym levy (Rs/ha)	Asym. Levy (Rs/ha)
1.	Srikakulam	30.23	41.85	41.85	692.75	132.50	132.50
2.	Vizianagaram	35.13	50.85	50.85	621.38	92.21	92.21
3.	Visakhapatnam	20.76	26.24	26.24	436.00	16.13	16.13
4.	East Godavari	39.48	59.34	59.34	765.18	179.66	179.66
5.	West Godavari	50.55	83.12	80.59	800.45	204.90	204.03
6.	Krishna	46.56	74.19	74.19	1070.87	448.13	272.96
7.	Guntur	48.18	77.77	76.81	715.71	146.77	146.77
8.	Prakasam	48.17	77.73	76.79	753.33	171.51	171.51
9.	Nellore	46.29	73.60	73.60	895.25	280.17	228.20
10.	Chittoor	38.93	58.23	58.23	978.84	355.49	249.51
11.	Cuddapah	42.29	65.07	65.07	955.00	333.15	243.43
12.	Ananthapur	37.77	55.94	55.94	941.43	320.74	239.97
13.	Kurnool	42.69	65.91	65.91	755.00	172.65	172.65
14.	Mahbubnagar	29.82	41.14	41.14	..	..	..
15.	Rangareddy	33.11	47.06	47.06	847.69	241.06	216.08
16.	Hyderabad	41.48	63.39	63.39	..	..	..
17.	Medak	37.05	54.53	54.53	740.74	163.04	163.04
18.	Nizamabad	41.25	62.93	62.93	889.82	275.56	226.81
19.	Adilabad	35.49	51.53	51.53	960.00	337.78	244.70
20.	Karimnagar	48.59	78.67	77.46	894.00	279.10	227.88
21.	Warangal	41.39	63.21	63.21	..	..	..
22.	Khammam	41.09	62.59	62.59	831.32	228.23	211.90
23.	Nalgonda	43.55	67.71	67.71	700.00	136.94	136.94
	Andhra	42.18	64.85	64.85	772.26	184.61	184.61

Table A8.1 (Contd..)

S. No.	Districts	Groundnut (anchor yield: 8.8 qtl/ha)			Cotton (anchor yield: 12.0 qtl./ha)		
		Yield (qtl/ha)	Sym. Levy (Rs/ha)	Asym. levy (Rs/ha)	Yield (qtl/ha)	Sym. Levy (Rs/ha)	Asym. Levy (Rs/ha)
1.	Srikakulam	9.78	27.44	23.16	4.89	19.86	19.86
2.	Vizianagaram	9.17	23.23	21.71	4.82	19.41	19.41
3.	Visakhapatnam	12.56	50.85	29.74	5.17	21.65	21.65
4.	East Godavari	14.57	72.07	34.50	4.87	19.75	19.75
5.	West Godavari	13.52	60.53	32.02	4.73	18.88	18.88
6.	Krishna	14.08	66.56	33.34	4.81	19.37	19.37
7.	Guntur	15.50	83.11	36.70	3.81	13.63	13.63
8.	Prakasam	12.44	49.69	29.46	8.02	43.77	43.77
9.	Nellore	22.92	198.90	54.27	4.82	19.45	19.45
10.	Chittoor	11.06	37.36	26.19	..	..	..
11.	Cuddapah	10.26	30.99	24.30	5.64	24.81	24.81
12.	Ananthapur	11.57	41.72	27.40	5.63	24.72	24.72
13.	Kurnool	8.91	21.54	21.10	5.65	24.85	24.85
14.	Mahbubnagar	7.58	13.82	13.82	5.04	20.79	20.79
15.	Rangareddy	11.67	42.60	27.63	5.88	26.48	26.48
16.	Hyderabad	..	..	..	..	..	..
17.	Medak	12.17	47.15	28.82	8.74	50.45	50.45
18.	Nizamabad	23.03	200.99	54.53	8.71	50.22	50.22
19.	Adilabad	12.79	53.09	30.29	5.82	26.05	26.05
20.	Karimnagar	11.21	38.62	26.55	14.21	116.62	102.91
21.	Warangal	10.54	33.15	24.96	12.38	91.52	89.67
22.	Khammam	12.09	46.40	28.63	9.93	62.61	62.61
23.	Nalgonda	7.85	15.26	15.26	6.98	34.81	34.81
	Andhra	10.82	35.39	25.62	7.26	37.18	37.18

Source: Yields from Andhra Pradesh Statistical Abstract for paddy and groundnut, and from District-wise Area of Production of Crops in India for sugarcane and cotton (converted from lint); farm harvest prices from ASI except for sugarcane, where gur wholesale prices from the Statistical Abstract was converted to sugarcane using relative factors from COC.

Table A8.2

Estimated Tax Revenue at District Level: Punjab 1997-98

Rank	Districts	Paddy (anchor yield: 49.84 qtl/ha)			Wheat (anchor yield: 37.08 qtl/ha)			Cotton (anchor yield: 10.95 qtl/ha)		
		Yield (qtl/ha)	Sym. levy (Rs/ha)	Asym. levy (Rs/Ha)	Yield (qtl/ha)	Sym. levy (Rs/ha)	Asym. levy (Rs/ha)	Yield (qtl/ha)	Sym. levy (Rs/ha)	Asym. levy (Rs/ha)
1.	Amritsar	45.15	80.35	80.35	37.77	77.72	76.98	2.45	7.13	7.13
2.	Bathinda	60.00	117.26	110.09	34.70	68.39	68.39	8.79	47.53	47.53
3.	Faridkot	57.32	110.20	105.16	41.38	89.37	84.34	4.46	16.52	16.52
4.	Fatehgarh Sahib	55.25	104.88	101.36	41.02	88.17	83.60	0.00	0.00	0.00
5.	Firozepur	54.17	102.14	99.38	39.74	83.98	80.99	8.35	43.76	43.76
6.	Gurdaspur	42.18	73.59	73.59	37.58	77.12	76.59	..	..	..
7.	Hoshiarpur	45.27	80.62	80.62	30.59	56.74	56.74	..	..	..
8.	Jalandhar	50.24	92.40	92.17	35.86	71.85	71.85	..	..	..
9	Kapurthala	44.85	79.65	79.65	34.12	66.69	66.69	..	..	..
10.	Ludhiana	57.63	111.02	105.74	42.10	91.78	85.80	10.19	60.78	60.78
11.	Mansa	56.90	109.11	104.39	35.54	70.89	70.89	9.80	56.88	56.88
12.	Moga	60.14	117.62	110.33	42.74	93.95	87.11	9.17	51.00	51.00
13.	Muktsar	51.96	96.63	95.33	34.60	68.09	68.09	5.85	24.90	24.90
14.	N.Shahr	50.58	93.24	92.80	35.61	71.10	71.10	..	..	..
15.	Patiala	49.50	90.62	90.62	40.55	86.62	82.65	12.23	82.71	76.55
16.	Ropar	48.14	87.35	87.35	35.60	71.25	71.25	..	..	..
17.	Sangrur	57.53	110.75	105.54	43.19	95.48	88.03	9.61	55.06	55.06
	Punjab	51.98	96.67	95.36	38.53	80.11	78.53	7.91	40.08	40.08

Source: Yields from District-wise Area and Production; farm harvest prices from ASI.

Table A8.3

Estimated Tax Revenue at District Level: Rajasthan 1998-99

Rank	Districts	Wheat (anchor yield:31.20 qtl/ha)			Cotton (anchor yield:12.45 qtl/ha)			Rape-Mustard (anchor yield: 9.76 qtl/ha)		
		Yield (qtl./ha)	Sym. Levy (Rs/ha)	Asym. levy (Rs/ha)	Yield (qtl/ha)	Sym. levy (Rs/ha)	Asym. levy (Rs/ha)	Yield (qtl/ha)	Sym. levy (Rs/ha)	Asym. levy (Rs/ha)
1.	Ajmer	17.92	38.07	38.07	5.13	44.35	44.35	5.07	19.01	19.01
2.	Alwar	35.60	96.78	91.51	8.13	80.80	80.80	10.01	57.75	56.73
3.	Banswara	20.86	46.37	46.37	6.41	58.97	58.97	9.58	.53.58	53.58
4.	Barmer	24.87	58.64	58.64	8.23	82.22	82.22	9.62	54.01	54.01
5.	Bharatpur	33.97	90.48	87.32	8.26	82.60	82.60	12.24	81.77	69.36
6.	Bhilwara	22.25	50.50	50.50	10.29	111.87	111.87	9.62	54.01	54.01
7.	Bikaner	20.55	45.47	45.47	12.45	147.02	147.02	6.61	28.91	28.91
8.	Bundi	29.78	75.12	75.12	9.81	104.66	104.66	9.98	57.47	56.56
9	Chittorgarh	24.11	56.24	56.24	8.26	82.55	82.55	9.47	52.56	52.56
10.	Churu	24.87	58.64	58.64	8.29	82.95	82.95	9.62	53.99	53.99
11.	Dholpur	36.21	99.16	93.07	..	..	..	8.07	40.12	40.12
12.	Dungarpur	20.48	45.28	45.28	8.34	83.67	83.67	7.50	35.56	35.56
13.	Ganganagar	28.47	70.57	70.57	8.02	79.35	79.35	8.31	42.17	42.17
14.	Jaipur	20.00	43.89	43.89	8.22	81.99	81.99	10.54	63.05	59.71
15.	Jaisalmer	24.87	58.64	58.64	8.26	82.52	82.52	9.62	53.97	53.97
16.	Jalore	16.77	34.98	34.98	11.51	131.24	131.24	9.41	52.00	52.00
17.	Jhalawar	19.16	41.49	41.49	8.46	85.35	85.35	9.62	54.01	54.01
18.	Jhunjhunu	29.74	74.97	74.97	8.25	82.47	82.47	12.16	80.83	68.90
19.	Jodhpur	21.57	48.47	48.47	11.22	126.61	126.61	12.37	83.33	70.11
20.	Kota	25.40	60.34	60.34	7.19	68.58	68.58	13.39	95.79	75.88
21.	Nagaur	11.85	22.77	22.77	7.54	73.02	73.02	9.65	54.27	54.27

Table A8.3 (Contd..)

Rank	Districts	Wheat (anchor yield:31.20 qtl/ha)			Cotton (anchor yield:12.45 qtl/ha)			Rape-Mustard (anchor yield: 9.76 qtl/ha)		
		Yield (qtl/ha)	Sym. levy (Rs/ha)	Asym. levy (Rs/ha)	Yield (qtl/ha)	Sym. Levy (Rs/ha)	Asym. levy (Rs/ha)	Yield (qtl/ha)	Sym. levy (Rs/ha)	Asym. levy (Rs/ha)
22.	Pali	14.71	29.67	29.67	9.88	105.71	105.71	6.31	26.83	26.83
23.	S.Madhopur	22.54	51.38	51.38	0.00	0.00	0.00	8.75	45.93	45.93
24.	Sikar	25.38	60.27	60.27	8.31	83.20	83.20	11.13	69.29	63.06
25	Sirohi	19.55	42.60	42.60	12.41	146.39	146.39	11.18	69.90	63.38
26.	Tonk	18.13	38.64	38.64	8.32	83.43	83.43	8.30	42.06	42.06
27.	Udaipur	23.03	52.87	52.87	7.99	78.98	78.98	10.08	58.46	57.13
28.	Baran	17.07	35.77	35.77	..	..	..	9.29	50.89	50.89
29.	Dausa	31.95	82.94	82.13	8.18	81.42	81.42	11.42	72.45	64.71
30.	Rajasamand	20.51	45.36	45.36	8.58	86.92	86.92	9.63	54.04	54.04
31.	Hanumangarh	26.83	65.01	65.01	7.58	73.50	73.50	8.64	45.02	45.02
32	Karoli	29.82	75.26	75.26	..	0.00	0.00	8.56	44.33	44.33
	Rajasthan	24.85	58.57	58.57	8.27	82.72	82.72	9.62	54.01	54.01

Source: Yields from Rajasthan Statistical Abstract; farm harvest prices from ASI.

Table A8.4

Estimated Tax Revenue at District Level: West Bengal 1997-98

S. No.	Districts	Paddy (anchor yield: 33.02 qtl/ha)			Potato (anchor yield: 251.87 qtl./ha)		
		Yield (qtl/ha)	Sym. Levy (Rs/ha)	Asym. levy (Rs/ha)	Yield (qtl/ha)	Sym. levy (Rs/ha)	Asym. Levy (Rs/ha)
1.	Burdwan	44.28	84.25	77.74	222.22	197.44	197.44
2.	Birbhum	41.52	77.50	72.90	180.27	141.84	141.84
3.	Bankura	41.07	76.42	72.11	204.69	173.17	173.17
4.	Midnapore	32.25	56.30	56.30	253.46	244.38	243.41
5.	Howrah	29.15	49.70	49.70	224.79	201.12	201.12
6.	Hooghly	39.71	73.17	69.71	192.12	156.68	156.68
7.	24-Parganas(N)	33.57	59.18	58.94	212.02	183.14	183.14
8.	24-Parganas(S)	22.14	35.73	35.73	190.21	154.24	154.24
9.	Nadia	36.87	66.59	64.73	211.51	182.43	182.43
10.	Murshidabad	38.96	71.41	68.39	203.19	171.16	171.16
11.	Uttar Dinajpur	29.07	49.54	49.54	172.35	132.30	132.30
12.	Dakshin Dinajpur	31.23	54.10	54.10	140.72	97.24	97.24
13.	Malda	36.21	65.08	63.57	185.30	148.06	148.06
14.	Jalpaiguri	16.68	25.73	25.73	190.21	154.24	154.24
15.	Darjeeling	19.02	29.92	29.92	143.63	100.26	100.26
16.	Cooch Behar	20.24	32.15	32.15	182.04	144.02	144.02
17.	Purulia	28.35	48.05	48.05	140.51	97.02	97.02
	West Bengal	33.65	59.35	59.07	209.47	179.64	179.64

Source: Yields from West Bengal Statistical Abstract; farm harvest prices from ASI