Withering Punjab Agriculture

Can It Regain Its Leadership?

March 2007

International Food Policy Research Institute (IFPRI)
New Delhi

Contact Person at IFPRI
Ashok Gulati, Director in Asia, IFPRI, New Delhi Office
Email: a.gulati@cgiar.org

Acknowledgements

This report is the synergistic product of numerous sources and people.

Ralph Cummings Jr., Ashok Gulati, P.K. Joshi and Kavery Ganguly took the responsibility of finalizing this report. Karl M. Rich and P. K. Joshi worked earlier on this report, but left the International Food Policy Research Institute (IFPRI) in July and September 2006 respectively. Their contributions are duly acknowledged.

This consolidated report draws on several background papers and studies specifically done for IFPRI. We would like to acknowledge the following papers/studies: 'Agricultural Diversification in the Punjab: Trends, Constraints, and Policy Options' by Rajinder Sidhu, P. G. Chengappa, Deepa Dhankar and Karl M. Rich; 'Input Subsidy in Punjab Agriculture' by Prem S. Vashishtha and Kanupriya Gupta; and 'Foodgrain Management: State and Private Sector in India with reference to Punjab' by Ravneet Kaur.

Several other papers and studies conducted by national and international agencies have been referred to during the course of the study, all of which have been duly acknowledged and cited in the report. Documents and data sources published by the Government of India and Government of Punjab have been used extensively in this report.

Usual disclaimers apply.

Executive Summary

Punjab agriculture was an undisputed leader in the Green Revolution in India and the Punjab farmer was acclaimed worldwide. But today Punjab agriculture no longer calls the shots, nor does it play the leadership role that others would want to emulate. The Punjab agricultural sector has reached a point where it must make significant changes if it wants to move forward and regain its leadership role. Conversely, if the state does not rationalize incentives, create new institutions and reinvigorate old ones, and increase investments significantly, it will suffer declining income and employment and irreversible environmental degradation.

This prospect gives rise to a number of questions: How can the Punjabi farmer again become a role model? Why is the process of change not moving faster and how can it be accelerated in an inclusive manner?

Introduction

Punjab has become the breadbasket of India. Agriculture is the prime mover of the economy, contributing a little less than 40 percent of the GSDP in contrast to only 20 percent at the national level. Agriculture is dominated by rice and wheat, which now cover over three-quarters of the cropped area and account for 85 percent of the gross value of crop output. Despite comprising less than 2 percent of the country's area, the state contributes over 10 percent of national rice production and over 20 percent of national wheat production and a significant portion of grains (38 percent for rice and 57 percent for wheat in 2003–04) to the Central pool for public distribution. Among Indian states, Punjab has the highest yields and lowest costs for rice and the highest yields and among the lowest costs for wheat. As a result, farmers' incomes in Punjab are higher than in other states. The state has very high density of tractors (106 per thousand ha compared to 22 per thousand ha at the all-India level) and irrigation (90 percent of cropped area compared to 40 percent at the all-India level) and high fertilizer use (double all-India average) with a cropping intensity of 186 percent (compared to the all-India average of 135 percent). It has good infrastructure—roads (with density 1.27, which is one and a half times the all-India density of 0.81), markets (during harvest, farmers can typically find a purchase center for foodgrains within 8–10 kms of their village, by far the best market density in the country), and communications [especially cell phones (with 200 million subscribers in February 2007) and computers].

However, increases in the production of rice have come at the expense of other crops such as cotton (cultivated area down by almost half since 1990–91), oilseeds, maize (cultivated area down by half since 1980–81), and millets. Essentially all high potential available land has been sown to wheat and paddy, and further land expansion is exhausted. The yield of rice has almost stagnated (increasing by only 0.02 percent annually during the 1990s) and of wheat has slowed down significantly (declining from 3.0 percent annual gain in the 1980s to 2.0 percent in the 1990s). The agricultural growth rate, largely driven by the performance of wheat and rice, which averaged 4 percent per annum in the 1970s and 5 percent in the 1980s (more than twice the corresponding national averages), declined significantly to 2.6 percent in the 1990s (compared to the all-India average of 3.2 percent), only buoyed up by the continuing strong performance of the livestock sector. The crop sector grew by only 1.3 percent per annum in the 1990s, down from 4.8 percent in the 1980s, and has had negative growth in the early 2000s. The Punjab agricultural sector has lost its place among the fastest growing state agricultural economies in the country; having been bypassed by a number of other states, including Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, and West Bengal.

Sustained economic growth, increasing urbanization, expanding trade liberalization and globalization, and changing lifestyle patterns are shifting consumption patterns in the economy away from basic staples such as wheat and rice, toward high-value agricultural commodities. The changes are occurring at all income levels. For example, while per capita consumption of cereals for the bottom 30 percent of income group in India declined by 10 percent over the period 1983 to 1999–2000, the consumption of milk increased by 30 percent, of vegetables by 50 percent, of meat, eggs, and fish by 100 percent, and of fruits by 163 percent over the same period. These changes are even more pronounced for higher income groups and apply to both rural and urban consumers. Global demand for high-value and processed commodities is also increasing. Their share in agricultural exports from India went up from less than 20 percent in 1990–91 to more than one-third in 2003–04. These changes in the domestic consumption patterns and in exports of high-value agricultural products point to a silent demand-driven revolution underway and raise the issue of whether the country is suffering from a supply or a demand constraint in the consumption of cereals, the dominant crop of Punjab.

Punjab is experiencing increasing stress on natural resources. Largely due to (especially early sown) paddy cultivation, groundwater levels are falling at a rate of almost one-quarter meter per year in the central zone. Large areas are being lost to

salinity and waterlogging, especially in the south-western cotton zone. Fertilizer, especially nitrogen, is being used at levels exceeding the recommended amounts, contributing to imbalances among nutrients (too much N relative to P and K), and micronutrient deficiencies have become serious (for example, zinc content is only 48 percent of the required level), resulting in low marginal returns to fertilizer (2 kg of grain to one kg of fertilizer). Thus, the sustainability of agriculture is under threat.

Diversification

Diversification toward high-value commodities—basmati and fine long-grained rice, durum wheat, fruits and vegetables, milk, poultry, fish and their processing—has already begun in Punjab. This high-value segment contributes over 40 percent (TE 2002–03) of the total value of agricultural output in the state. Dairy, the largest component, is particularly important for smallholders, accounting for 54.6 percent of farm business income on marginal (less than one ha) farms and 37.4 percent on small (1–2 ha) farms during 2002–03. It is also important for women who account for over 90 percent of the labor force working with farm animals, including dairy. However, Punjab is still a relatively minor producer of fruits and vegetables (producing 2.2 percent of the all-India total) even though it is one of the most productive states from the standpoint of yields compared to the rest of India (yields of onions and peas are nearly double the all-India average while the productivity of cauliflower, chilies, guavas, grapes, mangoes, potatoes, and tomatoes are all well above the all-India norms). Per ha net returns to high-value commodities are generally much higher—onions fivefold, green peas two and a half times, and potatoes double—than to wheat and rice. This course of diversification has been followed with considerable success by other countries in Southeast Asia. One vision of Punjab is that 60 percent of the area could be covered by citrus in 20 years—replacing California and Florida as the highest producing areas. Increased production of traditional commodities such as cotton, sugar cane, pulses, and poultry (and maize as feed) can also contribute significantly to higher farm incomes.

Innovative private sector initiatives—business-oriented cooperatives and contract farming—are emerging, as are also supermarkets. The Punjab government is trying to aggressively promote diversification and attract agri-business for processing, retailing, and exporting. The state is allowing the private sector to equip agricultural produce markets with modern facilities. But many farmers' groups and academics remain skeptical, given the not very happy experiences of such diversification attempts in the past in the state and elsewhere in India too.

Though all conditions favor Punjab to diversify it is not happening as would be expected. The incentives, institutions, and investments are still focused on producing wheat and rice—to respond to food security—and farmers are assured of high, stable returns for growing these crops. Thus farmers do not have any incentive to shift to something that is riskier.

Foodgrains Management

The government, through a Minimum Support Price (MSP), contracts with farmers to purchase all the wheat and rice produced by them at high and assured prices to provide food for the Public Distribution System (PDS). During 1996–2000, for wheat and paddy, the difference between MSP and C_2 averaged 36 percent and the difference between MSP and full costs was 26 percent. The costs of grain management have skyrocketed.[1] Private marketing is inhibited. Despite huge foreign exchange reserves, the mindset for food self-sufficiency has limited use of the international market to import foodgrains only as a last resort. The rationale for continuing this practice is highly questionable. Guaranteed high returns for wheat and rice and their assured procurement discourage diversification, for which both production and price risk is high.

Subsidies

Fertilizers, irrigation, and electric power are being provided at low, sometimes zero, costs. Largely due to political considerations, the government has gotten away from providing affordable, reliable services. Costs through subsidies have skyrocketed. Because of landholding distribution, the largest amount of subsidies goes to medium and large farmers despite the fact that the subsidies have been justified, in part, to benefit the smallholder. Productivity is stagnating (marginal returns to fertilizers and water are low). Resources are misallocated (paddy is being sown too early, too much nitrogen is being applied relative to phosphorus and potash, too much water is being pumped and applied, especially on rice). The environment is being harmed—the water table is declining rapidly in the central region [if the present trends continue, the

[1] The cost of grain management has three main components: (i) quantity procured, (ii) price of procurement, and (iii) costs of operation. Of particular concern has been the fact that since the mid 1990s MSP has increased much faster than C_2, widening the profit for the Punjab farmer. During 1981–89, the average difference between MSP and C_2 was 20 percent for wheat and 14 percent for paddy. In 1990–95, it widened to 21 percent for wheat and 19 percent for paddy. During 1996–2000 (reported above) the differences were even wider. The good news is that the MSP has been almost frozen since then.

proportion of blocks in Punjab falling in the critical level of water table is likely to increase from one-quarter (35 of 141 total) in year 2000 to reach an alarming figure of half (72) in 2030] and increasingly land is being lost to salinity, especially in the south-western region (where almost 16 percent of net irrigated area is degraded due to seepage from canals and/or excessive irrigation). State organizations [such as the State Electricity Board (SEB)] are being bankrupted, progressively providing poorer quality services—power surges burn out irrigation pump motors, and maintenance on canal irrigation systems is declining. For TE 2000–01, subsidies on fertilizer, power, and water cost the federal and state governments over 10 percent of agriculture SDP compared to state expenditures of only 1.9 percent (2.2 percent for all-India) for public capital investments—the precursor to future growth—and only 2.7 percent (by far, the lowest among major agricultural states; 5.6 percent for all-India) for current expenditures—which fund O&M for irrigation, research and extension, and other important needs. Diversification is discouraged because subsidies are promoting input-intensive wheat and rice and diverting budgetary support from higher return investments.

Policy Suggestions

The changing scenario demands a different role for government in the future than it has exercised in the past. Food security is much more than foodgrains self-sufficiency or availability alone.[2] And achieving food security is much more than the Punjab government's responsibility alone. Economic forces, led by market demand—domestically and globally—if allowed to operate, will drive the road to diversification, under the leadership of the private sector. Increased incentives can contribute to 'getting prices right'. Strengthened institutions can change the rules of the game in addition to the organizations in which they are embedded—for example, prices will never truly be effective allocators of resources if markets are not effective, so the challenge is also to 'get markets right'. Increased investment can provide the physical infrastructure and technologies necessary for creating and moving inputs, services, and commodities.

In the changing environment, it is equally important to specify what the government should not do as well as what it should do. It is equally important to present policies as a package in order to provide trade-offs to gain the necessary political support. The

[2] Availability no doubt is the key, and as long as India has adequate foreign exchange reserves, based on comparative advantage, it is perfectly alright to import foodgrains or any other food. There are many food items other than foodgrains in a well-balanced diet.

role of the government, therefore, should be to provide (i) public goods—particularly infrastructure and research, and (ii) policies to facilitate, guide, and monitor an inclusive process so that the pace of diversification accelerates and the benefits are distributed widely. The package should embrace changes in marketing and foodgrains management and input subsidies and promote diversification. The components of the required package are outlined below.

a. Foodgrains management: While continuing to pay attention to food security, one needs to decouple MSP as protection against price risk (support prices) from using it to augment income. Accordingly, we suggest the following:

   i. Facilitating strengthening of private marketing through reforming the Agricultural Produce Marketing Committee (APMC) Act, abolishing the Essential Commodities Act, eliminating movement and storage controls, permitting direct purchases by processors from farmers, implementing warehouse receipts, strengthening futures markets, and opening imports and exports to the private sector.

   ii. Targeting public distribution to the poor, through introduction of food coupons in due course.

   iii. Procuring foodgrains at market prices, where markets are freed of restrictions on movement, storage, and trade.

   iv. Stabilizing market prices in an open economy environment within a band bordered by c.i.f. and f.o.b. prices by using a variable tariff policy consistent with WTO Rules (within the bound rates).

   v. For farmers, mitigating the risk of precipitous fall in prices by setting the MSP at A_2/paid-out-cash cost levels.

   vi. Improving the efficiency of the Food Corporation of India (FCI)—in part, by making it compete with the private sector on a level playing field, and progressively downsizing the FCI.

b. Subsidies: Focusing on reforming prices has not worked in the past because attention was not paid to also reforming institutions. The goal should be to provide reliable services at affordable prices. Accordingly we suggest:

   i. Repricing fertilizer:

      - Dismantling the Retention Price Scheme that increasingly rewards the industry rather than the farmer.

- Revamping agricultural extension services to educate farmers on balanced use of NPK
- Bringing fertilizer prices more in line with economic costs.

ii. Reforming irrigation:

- Focusing on better utilization of the irrigation potential already created.
- Establishing and promoting water-user associations to improve maintenance and equitable allocation of water, make them truly participatory, and devolve powers by the irrigation department.
- Gradually increasing pricing to at least cover operations and maintenance (O&M) costs.
- Devolving solution to local/sub-zonal problems to correct regional inequalities.

iii. Reorienting power:

- Establishing and promoting User Committees to monitor quality improvements in power distribution.
- Dismantling/unbundling the State Electricity Board and privatizing parts—generation, transmission, and/or (especially) distribution—of its components with the objective of improving quality.
- Introducing variable pricing for peak/slack periods, using metering.[3]
- Targeting subsidies (perhaps using pre-paid cards) to smallholders (up to 2 ha).
- Sequencing reforms.

c. Diversification. All of the above would contribute significantly to stimulating diversification. However, more is needed. As we look to the future, key to future success are:

i. Promoting value-added processing, for example to convert grains such as wheat and dairy (mainly milk and butter) into bakery items, citrus such as kinnows and oranges into juice, and maize into fuel.

ii. Investing in and providing incentives to the private sector to modernize infrastructure and institutions to handle the special marketing and processing

[3] Including significantly raising rates for use during May–June in order to reduce groundwater discharge and falling water table.

needs of high-value commodities [like cold storage, sanitary and phyto-sanitary (SPS), etc.].

iii. Developing better yielding, better tasting, more stress-resistant varieties/hybrids of HVCs along the lines of what was done for wheat and rice.

What is required are the following:

i. Improving the links between farmers, processors, and retailers;

ii. Improving the environment in which HVCs can operate;

iii. Strengthening agricultural research on high-value commodities.

Our Vision

Looking into the future, we envision several features of a successful Punjab agriculture:

- Strong agricultural research at the Punjab Agricultural University (PAU) on HVCs (including upgraded quarantine to facilitate import of technical materials until the research system becomes more active).
- Modern processing plants located throughout the state, using kinnows and sweet oranges to produce juice, potatoes to produce chips, tomatoes to produce ketchup, milk to produce cheese and ice cream, sugar cane to produce sugar, maize to produce ethanol and poultry feed, etc.
- Bakery hubs around major *mandis* to process available wheat and dairy.
- Modern processing and retailing institutions such as business-oriented cooperatives, contract farming, and supermarkets linked to farmers through utilizing direct purchases from farmers, using contract arbitration of disputes, employing a range of risk mitigation strategies (insurance markets, storage infrastructure), and benefiting from direct foreign investment in food processing and retailing.
- Improved infrastructure including:

- Cold storage chains[4] (cold storage and refrigerated vans) located at selected *mandis* to hold and move perishable commodities to extend shelf-life and protect against excess production and price collapse.
- Improved highways/rail lines directly to major ports to facilitate exports to overseas countries.
- Improved highways to the Pakistan border to facilitate exports to Pakistan (and on to Afghanistan).
- International airport at Amritsar to facilitate exports to the Gulf, EU, and Central Asia.
- High-value commodities and a broader mix of traditional commodities accounting for 60 percent of Punjab agriculture and wheat and rice accounting for 40 percent.

We are confident that this would result in the highest per capita income, lowest poverty, and the most robust environmental sustainability among Indian states. The challenge is how to get to there from here.

We offer these recommendations, ideally to be implemented as a package. We do this because the political process will require trade-offs among winners and losers in particular activities. Our package is large. It is, in our view, a set of first-best solutions. In our list of priorities, the highest priority would be placed on (i) reform of the public foodgrains marketing system[5]—particularly decoupling of MSP and procurement, which could leave ample profitability for wheat and rice producers while making HVC more competitive for returns—and consequent strengthening of the private marketing system and (ii) facilitating the operation of new institutions and strengthening the linking of farmers to processors and retailers, which would unleash a wave of HVC value-added activity to satisfy the rapidly growing demand. We place high priority on reforming subsidies but even higher priority on 'getting the institutions right' before or simultaneously with 'getting the prices right'.

Punjab agriculture is clearly at a crossroad. All incentives at present are stacked in favor of wheat and rice. Incomes are stagnating in the near-term. While the situation is not yet at a crisis, in the longer term, however, changing demand and deteriorating environment will lead to progressively decreasing incomes. Keeping to the current

[4] Electric power, currently monopolized by agriculture, arguably would have high marginal returns applied to cold storage chains.
[5] Mainly the responsibility of the national government.

course does not promise an attractive future. Change is imperative and the relevant question is not ‘when’ but ‘what’ and ‘how’ it should be done. Whether Punjab can make the required changes to regain its leadership role in agriculture remains to be seen.

Table of Contents

List of Tables

List of Figures

List of Boxes

Acronyms

ACE	Agri Centre for Excellence
ADB	Asian Development Bank
AMAD	Agricultural Market Access Database
APEDA	Agricultural and Processed Food Products Export Development Authority (India)
APL	above the poverty line
APMC	Agricultural Produce Marketing Committee
B	Boron
BPL	below the poverty line
c.i.f.	cost, insurance, and freight
CACP	Commission for Agricultural Costs and Prices
CAP	cover-and-plinth
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo (International Maize and Wheat Improvement Center)
CMR	custom-milled rice
Comtrade	Commodity Trade Statistics Database
CRISIL	Credit Rating Information Services of India Limited
ECA	Essential Commodities Act
ERC	Expenditure Reform Commission
ERS	Economic Research Service
EU	European Union
FAO	Food and Agriculture Organization
FAQ	Fair average quality
FAS	Foreign Agricultural Service
FCI	Food Corporation of India
FDI	Foreign Direct Investment

Fe	Iron
FFL	FieldFresh Foods (P) Limited
FL	family labor
FOODSUP	Department of Food and Supplies
FPS	fair price shop
GCA	gross cropped area
GOI	Government of India
GOP	Government of Punjab
GSDP	gross state domestic product
Ha	hectare(s)
HLL	Hindustan Lever Ltd.
HVC	High-value commodities
HYV	High-yield Variety
ICAR	Indian Council of Agricultural Research
ICRA	Investment Information and Credit Rating Agency of India
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IMPP	import parity prices
ITC	Indian Tobacco Company Ltd.
LCC	Leaf Color Chart
Markfed	Punjab State Cooperative Supply and Marketing Federation Ltd.
MoU	Memorandum of Understanding
MSP	minimum support price
N	Nitrogen
NPK	nitrogen–phosphorus–potassium
NSS	National Sample Survey
NSSO	National Sample Survey Organisation
O&M	operations and maintenance
OECD	Organisation for Economic Cooperation and Development

PAFC	Punjab Agro Foodgrain Corporation Ltd.
PAGREXCO	Punjab Agri Export Corporation Ltd.
PAIC	Punjab Agro Industries Corporation Limited
PAU	Punjab Agricultural University
PDS	Public Distribution System
PSEB	Punjab State Electricity Board
PSERC	Punjab State Electricity Regulatory Commission
PSFC	Punjab State Farmers' Commission
PSTC	Punjab State Tubewell Corporation
PSWC	Punjab State Warehousing Corporation
PUNGRAIN	Punjab State Grain Procurement Corporation
PUNSUP	Punjab State Civil Supplies Corporation Ltd.
QPM	Quality Protein Maize
R&D	research and development
RBI	Reserve Bank of India
RPDS	Revamped Public Distribution System
RPS	Retention Price Scheme
RSC	Residual Sodium Carbonate
RWCS	rice–wheat cropping system
SCC	Selective Credit Control
SDP	state domestic product
SDR	Special Drawing Right
SEB	State Electricity Board
SERC	State Electricity Regulatory Commission
SNF	solids not fat
SPS	sanitary and phyto-sanitary
TE	Triennium ending
T&D	transmission and distribution

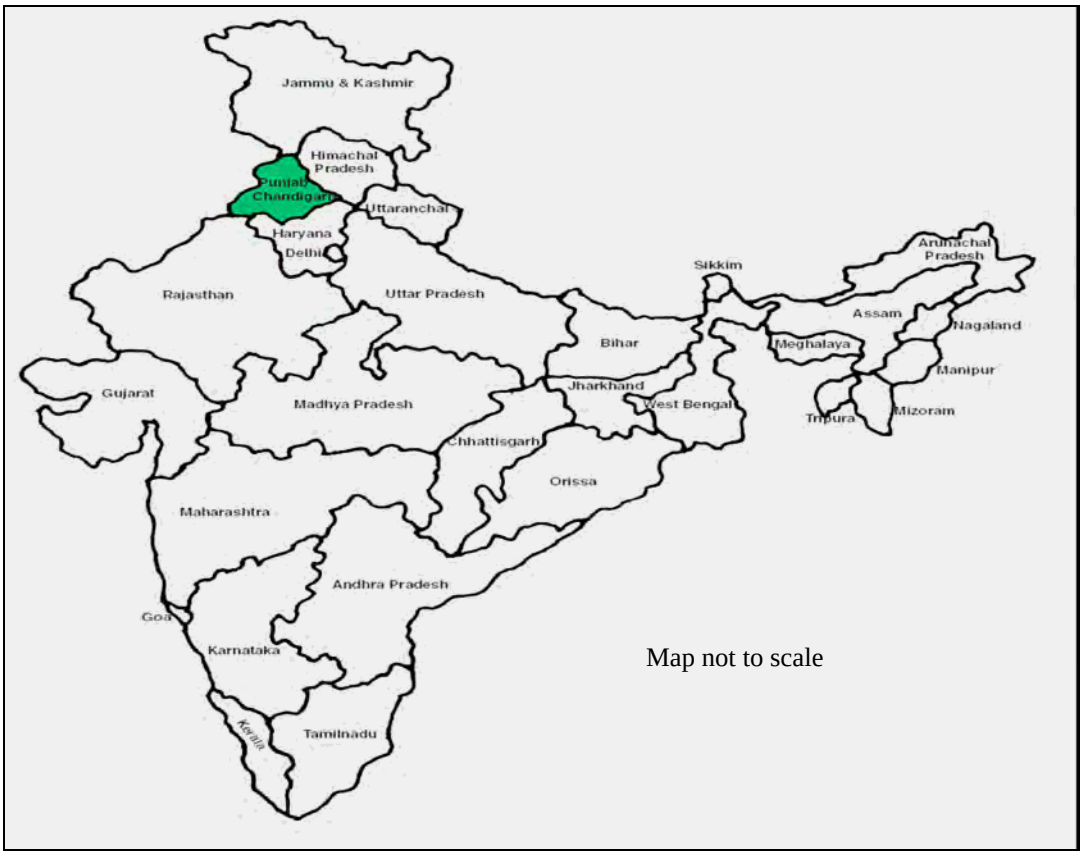
TFP	total factor productivity
TPC	total plate count
TPDS	Targeted public distribution system
TR	Total returns
UAE	United Arab Emirates
UIP	ultimate irrigation potential
USA	United States of America
USDA	United States Department of Agriculture
VC	Variable costs
WTO	World Trade Organization
WUA	Water Users Association
Zn	Zinc

Chapter 1
Introduction and Motivation for the Report

1.1 Characteristics of Punjab

In contrast with much of the rest of India, agriculture is the dominant economy in the state of Punjab, with the state having become the breadbasket of India. In 2004–05, agriculture accounted for almost 37 percent of the gross state domestic product (GSDP). While the state comprises only 1.6 percent of India's geographical area (see Figure 1.1) and just 3 percent of the country's net cultivated area, it accounts for over 20 percent of the country's wheat production and over 10 percent of rice production (see Appendix Table A1.1 for other selected key indicators). Two-thirds of the state's population lives in rural areas and mostly relies on agriculture for its livelihood. Among major Indian states, Punjab has the lowest poverty ratio (6 percent in 1999–2000) and ranks a close second to Maharashtra in per capita income.

Figure 1.1: Location of Punjab State in India



Source: www.mapsofindia.com, accessed February 10, 2006.

Agriculture in Punjab has a disproportionately high fertilizer consumption (double the all-India average), number of tractors (14 percent of the all-India total), irrigated area (10 percent of the all-India total), and cropping intensity (186 percent compared to 135 percent for the all-India average) (see Appendix Table A1.1). In contrast to the rest of India, the average size of landholdings increased from 3.8 hectares (ha) in 1995–96 to 4.03 ha in 2000–01, while the total number of landholdings declined from 1.09 million in 1995–96 to 997,000 in 2000–01 (see Appendix Table A1.2).

On the basis of agro-climatic conditions, the state can be divided into three regions (see Figure 1.2):[1]

- Zone I, the sub-mountainous region, known as the Kandi region, has undulating topography and includes the districts of Gurdaspur, Hoshiarpur, Nawanshahr, and Ropar. Due to the denudation of the upper hills (resulting from overgrazing and deforestation), there is significant water runoff, which results in flash floods and heavy soil erosion. Sinking of tubewells and pumping of water is costly due to the deep water table and rocky soil. The declining water table is not as serious a problem as compared to other regions of the state, due in part to abundant rainfall. Relative to other zones, the cropping pattern of the area is more diverse because of heterogeneity in agro-climatic conditions, with the area producing crops such as wheat, rice, basmati rice, maize, oilseeds, fruits, and vegetables.
- Zone II, the central region, is also known as the 'sweet water' region and includes the districts of Amritsar, Kapurthala, Jalandhar, Ludhiana, Patiala, Fatehgarh, and Sangrur. It has a tight-knit system of irrigation, mainly through the use of tube-wells. The main cropping system is the rice–wheat rotation. The water table has been falling at an alarming average rate of 0.23 meters per year during the last decade, largely due to the massive increase in the number of tubewells—from 192,000 in 1970–71 to 1.2 million in 2003–04—inexorably fueled by power subsidies (World Bank 2003c). The falling water table and declining soil fertility pose a threat to the sustainability of the production environment of this region.
- Zone III, the south-western region, is popularly known as the cotton belt and includes Bhatinda, Faridkot, Mansa, Moga, Muktsar, and Ferozepur districts. This region is endowed with sandy soil and is much drier than the other two zones. In contrast with Zone II, the water table has been continuously rising during the past two decades at the rate of 20–22 cm per year (Hira et al. 1998) due to a higher

[1] District names are as per the Punjab government website http://punjabgovt.gov.in/punjabataglance/Administrative.htm, which also lists two other districts, namely Mohali and Trantaran, which fall in zones I and II, respectively. These districts were formed in 2006. In our study, Ropar covers Mohali while Trantaran is covered by Amritsar.

inflow of canal water. Over the last decade, there has been a fall in the area under cotton, which is attributed to a decline in its productivity. At the same time, the increase in area under rice cultivation has increased salt accumulation on the soil surface due to the continuous use of undergroundwater, which is brackish and has led to waterlogging of the soil. The flooding of paddy fields, with accompanying high humidity, has led to an increase in the incidence of pests.

Selected region-wise indicators are given in Appendix Table A1.3.

Figure 1.2: Agro-ecological Zones of Punjab

Source: www.mapsofindia.com, accessed February 10, 2006.

1.1.1 Increase in wheat and rice production, plateaus in area and yields

Wheat and rice accounted for three-quarters of the gross cropped area (GCA) in 2005–06.

While the area under wheat cultivation has experienced modest growth, production is now nearly triple that of the level in 1970–71, owing to significant yield improvements engendered by Green Revolution varieties (see Table 1.1).

Table 1.1: Area and Production of Wheat and Rice in Punjab in Selected Years, 1970–71 to 2005–06

Years	Wheat			Rice		
	Area ('000 ha)	% of gross cropped area	Production (million tons)	Area ('000 ha)	% of gross cropped area	Production (million tons)
1970–71	2,299	40.5	4.9	390	6.9	0.7
1980–81	2,812	41.6	7.7	1,183	17.5	3.2
1990–91	3,273	43.6	12.2	2,015	26.9	6.5
2000–01	3,408	43.0	15.6	2,612	32.9	9.2
2005–06(P)	3,468	43.6	14.5	2,642	33.1	10.2

Source: Government of Punjab, *Statistical Abstract of Punjab*, various years.

There has been steady growth in both gross cropped area and yields in rice. Production, from a small base, has increased over tenfold since 1970–71. Much of the additional area in rice has come at the expense of other crops, such as cotton and maize—for example, the area under cotton declined from 9.6 percent of GCA to 5.7 percent.

In value terms, wheat and rice contributed over 85 percent of the value of aggregate production of crops in 2001–02, as compared to less than 50 percent three decades earlier (see Appendix Table A1.4). In particular, the share of rice as a percentage of the total crop value has soared since the mid-1970s.

Essentially all available high potential land is now sown under wheat and paddy. Prospects for further expansion of land have been exhausted (see Table 1.2).

Table 1.2: Cropped Area, 2003–04

Crop	*Rabi* ('000 ha)	*Kharif* ('000 ha)
Net cropped area	4,238	
(% of total land area)	(84.2)	
Wheat	3,444	
(% of net cropped area)	(81.3)	
Rice		2,614
(% of net cropped area)		(62.3)
Maize		154
Groundnuts		4.4
Cotton		452
Sugar cane		123
Barley	23	
Gram	6	
Rapeseed and mustard	52	
Vegetables:		
Potato	71.9	
Tomato		7.4
Onion		7.1
Chilies		9.2
Cauliflower	5.2	
Peas		16.0
Fruits		
Kinnow	17.2	
Oranges and Malta	2.5	
Mango	6.2	
Guava	7.0	
Other fruits	11.1	
Gross cropped area	7,905	
(cropping intensity)	(1.86)	

Source: Government of Punjab, *Statistical Abstract of Punjab 2004;* Directorate of Horticulture, Government of Punjab.

Despite the support given to agriculture, in particular to rice and wheat—via assured procurement through minimum support price—the rate of growth in yields for both commodities has declined over the last decade (see Table 1.3). In the case of wheat, annual growth rates for yields were well over 2 percent during the 1970s and 1980s, but fell to 2 percent during the 1990s and have been negative since then. The annual growth rate of yields for paddy fell from nearly 4 percent during the 1970s to 1.3 percent during the 1980s and to a mere 0.02 percent during the 1990s but has shown a recovery since then.[2]

[2] The World Bank (2003c) notes that the available evidence, viz. zero trend growth in rice yields in the 1990s, suggests that average yields in rice may indeed have plateaued at around 3,500 kg per ha with the available technology (statistical tests confirmed a significant break in the trend of rice yield in the

Table 1.3: Yield Levels and Growth Rates of Rice and Wheat, 1970–2006

	Rice	Wheat
Average yield (kg per ha)		
TE 1982–83	2,942	2,888
TE 1989–90	3,148	3,600
TE 1999–2000	3,322	4,293
TE 2005–06	3,832	4,223
Exponential growth of yield (%)		
1970s*	3.8	2.4
1980s	1.3	3.0
1990s	0.02	2.0
2001–06	2.9	-1.4

Note: * Calculated from different, although comparable, data series.
Source: CMIE (2005); Author's calculations.

High-value grains, though growing rapidly, remain a small proportion of production. Between 1996–97 and 2003–04 the area under basmati increased from 3 percent to 8 percent of the area under rice. Yields for basmati are much lower than for ordinary rice, but have improved significantly from 1,345 kg per ha in 1996–97 to over 1,800 kg per ha in 2003–04. As a result, basmati rice accounted for a little less than 4 percent of the total rice production in 2003–04, a sizable increase from a little over 1 percent in 1996–97. Anecdotal evidence suggests that durum wheat is a minor crop in Punjab.

1.1.2 Decelerating Factor Productivity

The declining water table in Punjab has raised serious doubts about the sustainability of the rice–wheat crop rotation. The change in factor productivity has already begun to show troubling signs. Singh and Hossain (2002) showed that growth in total factor productivity (TFP) for rice was negative (-1.77 percent per annum) during the period 1990–91 to 1996–97, with the component of technical change occurring at a very slow pace (0.89 percent per annum). In the case of wheat, although TFP growth was positive (1.24 percent per annum), the growth in technical change was slow (1.01 percent per annum) during the period 1990–91 to 1997–99. For both paddy and wheat,

1990s from the 1970s and 1980s). The experience during the last couple of years may have revised that upper limit a bit higher. In wheat, moderate gains (2 percent per annum yield growth) still occurred in the 1990s, largely due to the continuous release of higher yielding varieties. The experience during the recent years suggests that the limit is being reached. In both crops though, the average state yields are about 80 percent of the yields realized by scientists in demonstration plots using the best available technology—a very low yield gap by even developed country standards. This picture may change in the future with new technologies—'super wheat', which is in its final testing phases, and hybrid rice, which is being used extensively in China—which are yet to be adopted in any large degree in Punjab.

environmental degradation (sustainability) was found to contribute negatively to TFP, with the negative contribution being much larger in paddy (-5.04 percent per annum) than in wheat (-1.58 percent per annum).

Kumar (2002) showed that TFP growth in Punjab has been negligible in the 1990s (0.05 percent per annum) relative to the 1980s (1.55 percent per annum). On a zonal basis, Zone III had the greatest reduction in TFP (-2.04 percent per annum during 1990–96). In Zone II also, TFP growth fell sharply from 1.62 percent per annum in 1981–89 to 0.67 percent in 1990–96. Zone I was the only region in which TFP grew at a reasonable rate (2.05 percent per annum) in the period 1990–96.

1.1.3 Stagnation in Agricultural Growth

The agricultural growth rate, largely driven by the performance of wheat and rice, which averaged 4 percent per annum in the 1970s and 5 percent in the 1980s (more than twice the corresponding national averages), has decelerated significantly to 2.6 percent in the 1990s (compared to the all-India average of 3.2 percent), only buoyed up by the continuing strong performance of the livestock sector (see Table 1.4). The crops sector grew by 1.3 percent per annum in the 1990s, down from 4.8 percent in the 1980s. In the beginning years of the current decade, agricultural sector growth fell below one percent per year and the crops sector showed negative growth rate. The agricultural economy of Punjab is no longer among the fastest growing in the country, having been overtaken by a number of other states, including Karnataka, Madhya Pradesh, Maharashtra, and Rajasthan, apart from West Bengal, which was already growing faster than Punjab in the 1980s (World Bank 2003c).

Table 1.4: Sub-sectoral Agricultural Growth in Punjab

Sectors	Share in agricultural SDP (percent)	Growth rate (percent per annum)		
		1980s	1990s	2000–01 to 2003–04
Agriculture	100	5.0	2.6	0.8
Crops	66.8	4.8	1.3	-0.3
Livestock	32.0	5.6	5.3	3.1
Fisheries	0.9	12.8	18.0	15.1
Forestry	0.3	-0.1	2.8	-4.0

Source: World Bank (2003c); Government of Punjab, *Statistical Abstract of Punjab*, various years; Government of India, *National Accounts Statistics*, various years.

1.1.4 High Profitability of Wheat and Rice Production

Punjab is a very efficient producer of wheat and rice. As compared to other Indian states, Punjab has the highest yields and low costs for both foodgrains—lowest costs for rice and among the lowest for wheat [see Table 1.5 for yield and costs for the triennium ending (TE) 2002–03]. The government has guaranteed rising and assured prices. Consequently, profits and incomes from wheat and rice are high. However, because both area and yields are plateauing, future income gains will be confined to increases in prices.

Table 1.5: Yields and Costs of Production of Wheat and Paddy in Punjab Compared with Other Major Producing States, TE 2002–03

State	Wheat		Paddy	
	Yield (quintal per ha)	A_2 cost (Rs per quintal)	Yield (quintal per ha)	A_2 cost (Rs per quintal)
Uttar Pradesh	31.5	249.9	32.3	240.5
Punjab	44.7	247.3	58.6	238.5
Haryana	41.1	227.3	39.9	319.3
Madhya Pradesh	18.0	316.6	15.3	357.4
Rajasthan	32.5	230.7	-	-
West Bengal	-	-	33.8	270.7
Andhra Pradesh	-	-	48.5	290.8
Tamil Nadu	-	-	46.5	354.3

Note: A_2 cost measures total cash costs.
Source: Government of India, *Reports of the Commission for Agricultural Costs and Prices*, various years.

1.1.5 Deteriorating Water Availability and Quality

Punjab faces a major crisis with respect to groundwater, due in large part to growth in paddy, particularly to the early sowing of the crop. In Zone II, the proportion of area with depth of the water table greater than 10 meters rose from 3 percent in 1973 to 53 percent in 2000 (see Table 1.6). Most districts in Zone II exhibit severe over-exploitation of water resources.

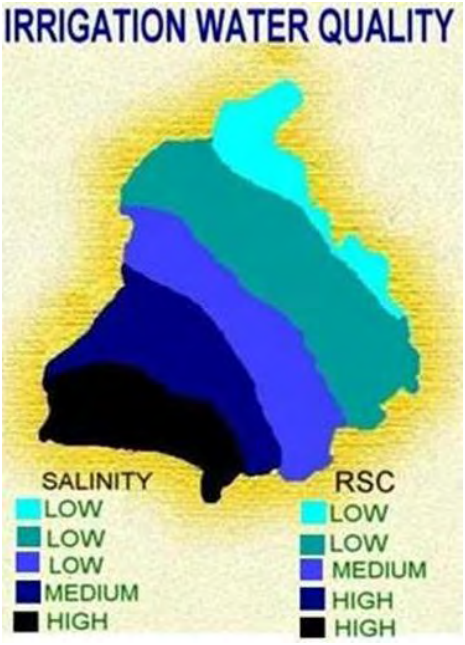
Table 1.6: Proportion of Area and Water table Depth in Different Hydrological Zones of Punjab

Year	Zone I			Zone II			Zone III		
	Water table depth (meters)			Water table depth (meters)			Water table depth (meters)		
	<5	5–10	>10	<5	5–10	>10	<5	5–10	>10
1973	32	32	36	39	58	3	39	25	36
1994	23	44	33	6	48	46	30	56	14
2000	30	47	23	6	41	53	41	50	9

Source: Government of Punjab (2002).

Zones II and III are adversely affected in terms of water quality, particularly with respect to salinity levels (see Figure 1.3).

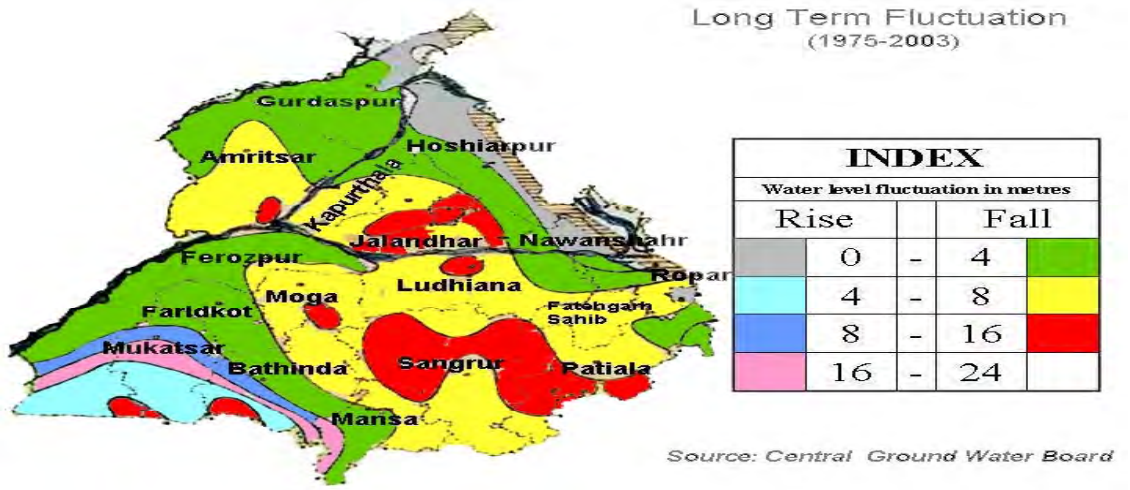
Figure 1.3: Irrigation Water Quality in Punjab



Note: RSC: Residual Sodium Carbonate
Source: Department of Soil and Water Conservation, Punjab website http://dswcpunjab.gov.in/contents/map_gallery_1.htm, accessed March 15, 2006.

Certain districts face significant fluctuations in the amount of water available on a year-to-year basis (see Figure 1.4). In some districts in Zone II (Ludhiana, Jalandhar, Patiala, and Sangrur), fluctuations have been reported to a depth of 16 meters. Other districts in the central zone have reported fluctuations of up to 8 meters.

Figure 1.4: Long-term Fluctuations in Water Levels in Punjab, 1975–2003



Waterlogging and increase in salinity in several parts of the state, especially in the southwest zone, have been caused by excessive seepage from canals and excessive irrigation from groundwater (through tubewells).

1.2 Motivation for the Report

The Punjab is at a crossroad with respect to agriculture. Agricultural growth based on wheat and rice has stagnated, leading to stagnation in incomes from agriculture. Environmental concerns have been escalating, particularly relating to high levels of and imbalance among fertilizers, decline in the water table, and loss of land to salinity. The rice–wheat system that brought food security to India through the broad dissemination of Green Revolution varieties in the 1960s and 1970s is mainly responsible for the stagnation of agriculture in the country today, and particularly in Punjab. This has been fueled by public policies at both the national and state levels that have distorted price and production incentives towards overproduction of foodgrains. Minimum support prices (MSPs) have provided farmers with assured incomes and markets for rice and wheat and discouraged large-scale movement

towards alternative crops. Input subsidies on fertilizer, irrigation, and power have compounded the problem. In the absence of suitable changes, the situation is likely to worsen.

The situation is not all gloomy, however. The livestock sector, led by dairy, grew at over 5 percent per year in the 1990s and helped steady the state's overall agricultural performance (World Bank 2003c). Punjab has an excellent system of roads, both in terms of coverage and quality, and during the harvest season, farmers can typically find a purchase center within 8–10 km of their village, which is by far the best market density in the country (World Bank 2003c). The Punjab Agricultural University (PAU) is one of India's leading teaching and research institutions. The Government of Punjab is committed to supporting agriculture.[3] Useful suggestions to improve the agricultural sector in the state have been provided by several recent studies and reports.[4]

Diversification in agriculture can provide the answer to bring Punjab back to predominance in agriculture and spur increased economic growth rates. Demand and export prospects are favorable for HVCs, in whose production the state has a comparative advantage. Institutional arrangements to reduce transactions costs and risks of smallholders are evolving and retail marketing may expand considerably in the future. Several of the traditional commodities—cotton, sugar cane, pulses, and poultry (with maize for feed)—use less water than do paddy and wheat and could increase incomes, especially as replacements for rice. However, in order to accelerate the pace of transition, changes must be made in incentives, institutions, and investments.

The focus of this report is three-fold. First, it assesses the ability of Punjab to diversify away from the rice–wheat system. Second, it examines grain management and subsidy regimes to determine the scope of public sector intervention and prospects for their rationalization. Third, it explores the most constructive role of public policy to manage the transition from the rice–wheat system to high-value commodities and a broader mix of traditional commodities.

The structure of the report is as follows. Chapter 2 provides an overview of the prospects for agricultural diversification in the state. Current trends and initiatives to promote high-value commodities and a broader mix of traditional commodities are discussed, including the drivers and economics behind high-value commodity

[3] However, for TE 2000–01, public capital expenditure—the precursor to future growth—was only 1.9 percent of agricultural SDP, less than the 2.2 percent for all-India.
[4] Government of Punjab (2002); World Bank (2003c); Government of Punjab (2005); Government of Punjab (2006c); Government of India (2002h).

production and promising forms of vertical coordination such as contract farming, cooperatives, and new retail organizations. Chapter 3 details the present structure of grain management that contributes to the predominance of the rice–wheat rotation. The chapter highlights the scope and nature of public policy intervention, while examining whether past rationales for public sector involvement are still valid today and whether the private sector can operate more effectively and efficiently than the public sector. Chapter 4 examines various components of input subsidies that further distort cropping patterns towards the rice–wheat system, hamper environmental sustainability, and siphon off public funds from more productive investments. The chapter provides a brief overview of the magnitude of each of the major subsidies (fertilizer, irrigation, and power), and examines their ramifications, including their impacts and beneficiaries. Reform options are suggested in Chapter 5.

Appendix Table A1.1: Key Indicators of Punjab *vis-à-vis* India

Indicator/ Parameter	Units	Year	Punjab	India	Punjab as proportion of India (%)
Geographical area	'000 ha	2001	5033	306,054	1.6
Population	Million	2001	24.35	1,028.61	2.4
Population density	Per sq. km	2001	484	313	
Literacy rate	Percent	2001	69.65	64.84	
Number of cultivators (% of total population)	Million	2001	1.894 (7.8)	103.89 (10.1)	1.8
Number of villages	Number	2002–03	12,428	587,258	2.1
Net sown area (% of area reporting)	'000 ha	2003–04	4,238 (84.20)	141,231 (46.15)	3
Total cropped area	'000 ha	2003–04	8,240	189,740	4.3
Cropping intensity	Percent	2003–04	186.00	134.34	
Gross irrigated area* (% of GCA)	'000 ha	2003–04	7,686.7 (93.28)	76,820.0 (40.48)	9.8
Fertilizer consumption	Kg per ha	2003–04	194.56	94.52	
Tractors	Number	2003–04	450,000	3,084,347	14.3
Tractor density	Per '000 ha of net sown area	2003–04	106	21.8	
Road density	Km per sq. km of area	1998–99	1.27	0.81	
Market density	Markets per hundred sq. km of area	2001–02	1.32	0.23	
Percentage of villages electrified	%	2002–03	100	83.8	
Foodgrains production	Million tons	2003–04	24.73	213.46	11.6
Area under foodgrains (% of GCA)	'000 ha	2003–04	6,293.5 (76.37)	123,446.5 (65.06)	5.1
Area under fruits and vegetables (% of GCA)	'000 ha	2003–04	196.7 (2.38)	11,055.3 (5.82)	1.77
Production of fruits and vegetables	'000 tons	2003–04	3,216.27	138,870.9	2.31
GDP/GSDP at factor cost	Rs billion (at 1993–94 prices)	2003–04	460.5	14,305.5	3.2
GDP/GSDP from agriculture and allied sectors at factor cost (% of GDP/GSDP)	Rs billion (at 1993–94 prices)	2003–04	171.62 (37.3)	3,106.11 (21.17)	5.5

Note: *Provisional
Source: Government of India, *Agricultural Statistics at a Glance, 2005*; Government of Punjab, *Statistical Abstract of Punjab*, various years; CMIE (2005); CSO official website http://mospi.nic.in/cso_test1.htm, accessed June 18, 2006.

Appendix Table A1.2: Number, Operated Area, Average Size, and Percentage Distribution of Landholdings in Punjab

	1990–91	1995–96	2000–01
	Number of holdings ('000)		
Marginal and small (0–2 ha)	500	387	296
	(44.8)	(35.4)	(29.7)
Semi-medium (2–4 ha)	289	320	328
	(25.9)	(29.3)	(32.9)
Medium (4–10 ha)	261	306	301
	(23.4)	(28.0)	(30.2)
Large (>10 ha)	67	80	72
	(6.0)	(7.3)	(7.2)
All groups	1,117	1,093	997
	Operated area ('000 ha)		
Marginal and small (0–2 ha)	492	362	320
	(12.2)	(8.7)	(8.0)
Semi-medium (2–4 ha)	842	835	876
	(20.9)	(20.1)	(21.8)
Medium (4–10 ha)	1,622	1,756	1,731
	(40.2)	(42.3)	(43.0)
Large (>10 ha)	1,077	1,200	1,096
	(26.7)	(28.9)	(27.2)
All groups	4,033	4,153	4,023
	Average size of landholding (ha)		
Punjab	3.61	3.80	4.04
All-India	1.55	1.41	1.37

Note: Figures in parentheses are percentages
Source: Indiastat website www.indiastat.com, accessed June 12, 2006.

Appendix Table A1.3: Selected Indicators of Agriculture in Punjab, by Zone, TE 2003–04

Region	Zone I	Zone II	Zone III	State
Size				
Net sown area ('000 ha)	727	1,979	1,524	4,231
% net sown area	17.19	46.78	36.03	100
Tubewells				
Number ('000)	148	512	195	856
% distribution	17.33	59.87	22.81	100
Density*	204	259	128	202
Tractor density				
Number ('000)	46	224	180	450
% distribution	10.25	49.68	40.07	100
Density*	63	113	118	106
Canal irrigation				
Area ('000 ha)	54	357	634	1,045
% distribution	5.14	34.21	60.65	100
Cropping intensity	1.7	1.9	1.9	1.86
Yield (kg per ha)				
Rice	1,058	3,663	3,674	3,584
Wheat	3,943	4,535	4,176	4,313

Note: * per '000 ha sown area.
Source: Government of Punjab, *Statistical Abstract of Punjab*, various issues.

Appendix Table A1.4: Changes in the Gross Value of Crop Output in Punjab, Selected Years 1967–68 to 2001–02 (in Rs million at constant 2001–02 prices)

	Rice	Wheat	Cotton	Oilseeds	Pulses	Sugar cane	Other cereals	Aggregate
1967–68	2,394	21,036	10,203	4,571	7,637	432	5,872	52,145
	(4.59)	(40.34)	(19.57)	(8.77)	(14.65)	(0.83)	(11.26)	(100)
1980–81	18,757	48,365	17,490	2,677	6,675	353	4,111	98,428
	(19.06)	(49.14)	(17.77)	(2.72)	(6.78)	(0.36)	(4.18)	(100)
1990–91	37,735	76,602	29,062	1150	7,872	540	2,272	155,232
	(24.31)	(49.35)	(18.72)	(0.74)	(5.07)	(0.35)	(1.46)	(100)
2001–02	51,133	98,217	19,569	930	2,006	838	2,696	175,389
	(29.15)	(56.00)	(11.16)	(0.53)	(1.14)	(0.48)	(1.54)	(100)

Note: Computed by using production figures for individual crops. Figures in parentheses are percentages.
Source: Government of Punjab, *Statistical Abstract of Punjab*, various years.

Chapter 2
Prospects for Agricultural Diversification in Punjab

In order to revitalize agriculture, the Government of Punjab (GOP) constituted a number of expert committees (e.g., the Johl Committee, 2002, and the Alagh Committee, 2005) to explore alternatives to the rice–wheat system. The problem has also been addressed by other groups (Government of Punjab 2006c). These expert committees and groups have recommended the diversification of agriculture towards high-value commodities and a broader mix of traditional commodities and agro-processed products that augment farm income, promote exports, and conserve soil and water resources.

Making the transition towards HVCs will not be easy. Such a transition would involve greater understanding of the trends in future domestic and global demand patterns and the process of diversification. While the existing policy environment encourages the production and marketing of rice and wheat the promotion of HVCs and traditional commodities would require new supply chains and innovative institutional arrangements that are at present either absent or underdeveloped. The Punjabi farmer is ready to respond to the process of diversification provided there is a mechanism that takes care of the associated production and market risks.

The time for change is opportune. If the cards are played well, Punjab could lead a take-off in agriculture. However, if decisions are made wrongly or delayed too long, the state could miss the boat. This chapter reviews the trends in domestic demand, international markets, and diversification in Punjab; the economics of high-value commodities; new institutional forms linking the farmer with contract farming, cooperatives, and supermarkets; and Punjab government programs to support high-value commodities.

2.1 Trends in Domestic Consumption Patterns

Evidence from India suggests a declining trend in the share of food expenditure in the country on cereals, with a corresponding rise in expenditure towards milk and milk products, meat, eggs, fish, fruits, and vegetables (Kumar and Mruthyunjaya 2002; Dev et al. 2004*).* The quantity of cereals consumed per person per month declined from 13.4 kg in 1993–94 to 12.1 kg in 2004–05 in rural India and from 10.6 kg to 9.9 kg in urban India (NSSO 2006). For all-India, per capita consumption of wheat grew by a

mere 3.9 percent in the 1990s as compared to 18.2 percent in the 1980s; per capita consumption of rice declined by 6 percent in the 1990s as compared to a growth of 16.3 percent in the 1980s. In contrast, during the 1990s, per capita consumption of vegetables grew by 12.9 percent, fruits by 38.6 percent, milk by 20.6 percent, eggs by 25 percent, and fish by 38.5 percent. Demand for high-value commodities has been fueled by rising incomes, increasing urbanization, expanding trade liberalization and globalization, and changing lifestyle patterns in both urban and rural areas.

Just as in the rest of India, expenditures on food items in Punjab have been changing (see Table 2.1). There has been a steady decline in the share of expenditures on cereals, comprising 18 percent of food expenditures in the 60th NSSO round, well below the all-India average in rural areas (34 percent) and slightly below the all-India average in urban areas (19 percent). Households in Punjab spend over two times the national average on milk and milk products, with nearly 36 percent of rural food expenditure and 31 percent of urban food expenditure allocated to these products. As with the rest of India, the share of fruits and vegetables in the consumption basket has increased, rising from 7 percent of the food basket in rural areas in 1977–78 to nearly 13 percent in 2003; in urban areas, the proportion of such expenditures rose from 11 percent to over 15 percent over the same period. Households in both urban and rural areas in Punjab consume slightly less than the all-India average in fruits and vegetables.

Table 2.1: Percentage of Expenditure on Food Major Categories, Punjab and All-India, Various Years

Consumption item	NSS Round							
	32nd (1977–78)	55th (1999–2000)	59th (2003)	60th (2004)	32nd (1977–78)	55th (1999–2000)	59th (2003)	60th (2004)
	Punjab				India			
	Rural							
Total cereals	26.7	19.02	17.91	17.98	51	37.3	33.1	33.54
Pulses and pulse products	4.81	5.79	4.9	4.57	5.9	6.4	5.89	5.53
Milk and milk products	33.5	32.94	34.96	35.88	12	14.7	15	15.63
Edible oil	5	5.68	7.8	8.72	5.6	6.3	8.25	8.53
Meat, eggs, and fish	1.83	1.45	1.02	0.75	4.1	5.6	6	6.1
Vegetable and fruits	7.13	12.11	12.75	11.39	7.7	13.3	15.1	14.02
Others	21	22.9	20.04	20.69	13.7	16.4	16.3	16.63
Food total	100	100	100	100	100	100	100	100
Food total (Rs per capita per month)	NA	388	402.6	431.76	NA	288.8	299	304.6
	Urban							
Total cereals	23	17.8	17.1	17.9	34.1	25.7	23.8	19.45
Pulses and pulse products	4.4	5.9	4.71	4.68	5.9	5.9	5.3	4.17
Milk and milk products	29.0	30.7	31.4	31.02	15.9	18.1	18.6	15.47
Edible oil	7.2	6.07	7.96	8.91	7.8	6.5	8.2	8.16
Meat, eggs, and fish	2.2	2.21	1.48	1.05	5.7	6.5	6.35	7.44
Vegetable and fruits	11	14.5	15.3	13.03	10.6	15.7	16.1	18.64
Others	23	22.8	21.4	23.39	20	21.6	21.4	26.67
Food total	100	100	100	100	100	100	100	100
Food total (Rs per capita per month)	NA	423.5	459.4	417.6	NA	410.9	429	528.73

Note: NA: Not available
Source: NSSO (1978, 2000, 2003, 2004).

In urban areas, demand for dairy products is strong (nearly 11 kg per capita per month) and nearly double the all-India average (5.80 kg per capita per month). Nearby markets such as Himachal Pradesh (almost 12 kg per capita per month), Haryana

(10.17 kg per capita per month), and Delhi (9.91 kg per capita per month) all exhibit strong demand for milk products. In the case of vegetables, urban consumption in Punjab is higher than the all-India average (6.81 kg per capita per month compared to 6.05 kg per capita per month), but lower than in nearby markets such as Delhi, Chandigarh, Uttar Pradesh, and Jammu and Kashmir. Consumption of fruits is lower in Punjab compared to the national average, but as in the case of vegetables, there is above-average demand in nearby areas such as Chandigarh, Delhi, and Himachal Pradesh. Combined, these figures highlight the potential sources of demand for Punjab to exploit.

2.2 Trends in International Markets for HVCs

The demand for imported fruits and vegetables in foreign markets has steadily increased in the 1990s and the current decade (see Appendix Table A2.1). In particular, the growth in the value of such imports has been especially strong in the Middle Eastern markets [for example, Saudi Arabia, United Arab Emirates (UAE), Bahrain, Oman, and Qatar], which have traditionally been important export markets for Indian products in general. At the same time, lucrative markets in the European Union (EU) and the United States of America (USA) have each experienced strong import growth in fruits and vegetables and represent potential markets for Indian (and Punjabi) exports.

India is one of the largest producers of fruits, vegetables, and dairy products in the world, representing 11 percent of global vegetable production, 15 percent of global fruit production, and 14 percent of the world dairy production during 2001–03 (World Bank 2005; FAOSTAT). However, it remains a minor exporter of these products. According to the World Bank (2005), despite having had export unit values of fruits and vegetables that were 63 percent and 53 percent, respectively, of the world price in 2001–03, India contributed just 0.5 percent of the global exports of fruits and 1.7 percent of global exports of vegetables during that period. In value terms, dairy exports were less than 1 percent of global exports of dairy and egg products in 2003 (FAOSTAT).

2.3 Trends towards Agricultural Diversification

The process towards agricultural diversification in Punjab has concentrated on dairy production although the area allocated towards fruits and vegetables, still relatively small, has steadily risen in recent years (see Table 2.2). The area sown under

traditional commodities, such as cotton, sugar cane, pulses, poultry (and maize for feed), and fodder (for dairy), has declined. Vegetables and fruits comprise a very small proportion of the gross sown area and it is understood that even if the area under them increases many folds, they may not be the only drivers of diversification. This necessitates bringing more land under the cultivation of maize, legumes, sugar cane, and cotton. Punjab should encourage farming of traditional crops, poultry, along with vegetables and fruits that are environmentally benign and ensure higher returns to the farmers.

Table 2.2: Shifts in Cropping Patterns in Punjab

(Area in'000 ha)

Crop	1970–71	1980–81	1990–91	1999–2000	2003–04	2004–05 (P)	2005–06 (P)
Rice	390	1,183	2,015	2,604	2,614	2,647	2,642
	(6.87)	(17.49)	(26.86)	(33.18)	(33.07)		
Maize	555	304	183	163	154	154	148
	(9.77)	(4.5)	(2.44)	(2.08)	(1.95)		
Groundnuts	174	83	11	5	4.4	4.3	
	(3.06)	(7.23)	(0.15)	(0.06)	(0.05)		
Cotton	212	502	637	381	452		
	(3.73)	(7.42)	(8.49)	(4.86)	(4.88)		
Sugar cane	128	71	101	108	123	86	84
	(2.25)	(1.05)	(1.35)	(1.38)	(1.56)		
Wheat	2,299	2,812	3,273	3,388	3,444	3,482	3,468
	(40.49)	(41.58)	(43.63)	(43.18)	(43.57)		
Barley	57	65	37	51	23	22	19
	(1)	(0.96)	(0.49)	(0.65)	(0.29)		
Gram	358	258	60	6	6	5.1	4
	(6.3)	(3.81)	(0.8)	(0.08)	(0.08)		
Rapeseed and mustard	103	136	69	56	52	60	
	(1.81)	(2.01)	(0.92)	(0.71)	(0.65)		
Potato	17	40	23	65	72		
	(0.3)	(0.59)	(0.31)	(0.83)	(0.91)		
Other vegetables	23	24	31	47	82		
	(0.41)	(0.36)	(0.41)	(0.6)	(1.03)		
Fruits	50	29	69	30	43.71	47.09	50.68
	(0.88)	(0.43)	(0.92)	(0.38)	(0.553)		
Gross cropped area	5,678	6,763	7,502	7,847	7,905	7,692	

Note: Figures in parentheses denote percentage of gross cropped area.
Source: Government of Punjab, *Statistical Abstract of Punjab*, various years.

Agriculture in Punjab is moving in the direction of more high-value commodities. A variety of traditional commodities are poised to reappear in the production mix. The challenge is whether it can move faster—and in an inclusive way.

2.3.1 Fruits and Vegetables

Punjab is a relatively minor producer of fruits and vegetables compared to the rest of India. The state contributed 2.27 percent of the all-India cultivated area to fruits and vegetables in 2002–03, a modest increase from its 1.51 percent share in 1991–92. Punjab produced 2.319 million tons of vegetables in 2002–03, which was less than 3 percent of the nearly 85 million tons produced in the country in that year.

Despite the fact that Punjab is a minor producer in fruits and vegetables, yields for most horticulture products are among the highest in the country, clearly highlighting the potential of such products in the state. For instance, yields for onions (21.5 tons per ha) and peas (6.2 tons per ha) are double the all-India average (9.9 tons per ha and 3.2 tons per ha, respectively), while the productivity of potatoes, cauliflower, mangoes, chilies, guavas, grapes, and tomatoes are all well-above all-India norms.

In 2003–04, 116,616 ha were devoted to production of major vegetables (defined here as potatoes, tomatoes, cauliflower, onions, chilies, and peas), representing just 1.48 percent of the gross cropped area (GCA) (see Table 2.3). The majority of vegetable production is devoted to potatoes. Punjab was the fourth-largest producer of potatoes in India in 2002–03, but this represented only 6 percent of the national production, well behind leading states such as Uttar Pradesh and West Bengal. The area allocated to vegetables increased by 12 percent in the period 1999–2000 to 2003–04, with onions and cauliflower accounting for the largest gains.

Table 2.3: Cultivated Area under Selected Vegetables in Punjab, 1999–2000 and 2003–04

Vegetable	1999–2000	2003–04	% change
Potatoes (ha)	65,020	71,900	11
Tomatoes (ha)	6,737	7,382	10
Onions (ha)	5,998	7,060	18
Chilies (ha)	8,218	9,150	11
Cauliflower (ha)	4,164	5,174	24
Peas (ha)	14,080	15,950	13
Total selected vegetables (ha)	104,217	116,616	12
Gross cropped area (‘000 ha)	7,847	7,905	
Area under vegetables as percentage of gross cropped area (percent)	1.33	1.48	

Source: Directorate of Horticulture, Government of Punjab.

The total area under fruit production in 2003–04 was 43,721 ha, representing just 0.55 percent of GCA (see Table 2.4). The main fruit grown in Punjab is the kinnow (a citrus, similar to Mandarin orange, used mainly for juice), although a number of other fruits such as oranges, mangoes, guavas, litchis, pears, and grapes are also grown. Out of the total area under fruit cultivation during 2003–04, kinnows represented 39 percent.

Table 2.4: Cultivated Area under Selected Fruits in Punjab, 1999–2000 and 2003–04

Fruit variety	1999–2000	2003–04	% change (1999–2000 to 2003–2004)
Kinnow (ha)	9,933	17,189	73
Orange and malta (ha)	3,417	2,553	-25
Mango (ha)	4,801	6,210	29
Guava (ha)	3,418	6,690	96
Other fruits (ha)	8,522	11,079	30
Total fruits (ha)	30,091	43,721	45
Gross cropped area ('000 ha)	7,847	7,905	
Area under fruits as percentage of gross cropped area (percent)	0.38	0.55	

Source: Directorate of Horticulture, Government of Punjab.

The production of both fruits and vegetables tends to be concentrated in particular regions of Punjab. Potato production predominates in Zones I and II and has been fueled by contract farming relationships (for example, with PepsiCo) in those areas. Tomatoes, cauliflower, and peas are concentrated in Zone I, while chilies are found more in Zone II. Zones I and III are the main kinnow-producing regions, with acreage in both zones having increased significantly.

There has been a somewhat stronger push towards high-value crops and away from traditional crops in Zones I and III. In Zone III, the acreage under cotton declined and under rice fluctuated during 1999–2004, with large increases in the area under kinnows (area doubling) and vegetables. Likewise, Zone I has seen a decline in the area under rice and increase in the area under potatoes, peas, and kinnows. Districts in which there has been a positive increase in the area under kinnows and a reduction in the area under rice are those outside the main rice–wheat belt. Most of these districts,

with the exception of Ferozepur, do not face as severe a problem with groundwater exploitation relative to regions in the main rice–wheat belt.

From the districts in the rice–wheat belt that have started to shift out of wheat and into kinnow production, only Moga has experienced a major change in its cropping pattern, with a 15 percent reduction in the area under wheat during 1999–2004. In Zone II, while there have been significant gains in the area under tomatoes and cauliflower (albeit from a small base), the area under rice increased by just over 2 percent during 1999–2004.

In five districts—Hoshiarpur, Kapurthala, Ropar, Fatehgarh, and Ludhiana—there was an increase in the area under vegetables and a decline in the area under wheat during 1999–2004. Of these five, Kapurthala, Ludhiana, and Fatehgarh all lie in the main rice–wheat belt and all face acute problems with groundwater exploitation. At the same time, the shift out of wheat has been relatively modest, with only Kapurthala moving over 3 percent of gross cropped area out of wheat production (and a corresponding increase of 36 percent in the area under vegetables).

The growth in fruits and vegetables in Punjab in recent years can be attributed to a number of events. The development of contract farming programs, first started by PepsiCo in 1989, have created new opportunities and market outlets for vegetable products, notably potatoes, tomatoes, and chilies. The entry of Bharti and Reliance into the retail food market in Punjab has the potential to streamline the supply chain and provide assured markets for high value commodities to the farmers. The Punjab state government, through the Punjab Agro Industries Corporation Limited (PAIC), has been active in recent years to promote agricultural diversification through contract farming by acting as a facilitator between farmers and private companies. Although kinnow production has been fueled by higher prices resulting from greater consumer demand, it is subject to fluctuations due to production risk. Other varieties that are rapidly coming up are sweet oranges and lemons. In particular, Punjab has made significant strides in improving the quality and consumer acceptability of kinnows in the market. The Council for Citrus and Fruit Juices in Punjab, a government enterprise that is into contract farming of citrus, has already leased in 1,000 acres of land from 28 farmers in southern Punjab and 500 acres of land from 22 farmers in the state's northern region (Singh 2006).

2.3.2 Dairy

The importance of the dairy sector as a commercial activity is a recent development. The establishment and growth of milk collection centers and processing units by milk cooperatives and private players such as Nestle India in the rural areas have been important developments. Dairying has assumed particular significance for smallholders since it uses little land and is labor-intensive. Dairy production contributed 54.6 percent of farm business income on marginal farms and 37.4 percent on small farms in Punjab during 2000–03. The dairy sector generated 186 man-days of farm employment on marginal farms and 213 man-days on small farms compared with 82 man-days and 163 man-days, respectively, in the crop production sector (Sidhu and Bhullar 2004).[1]

Milk production is concentrated in the central and western parts of the state, with the highest volumes of production being found in the south-central districts of Sangrur and Ludhiana and the north-west district of Amritsar. In aggregate, milk production increased by 27 percent during 1996–2004 (see Table 2.5), with strong growth rates in Kapurthala, Moga, Mansa, Amritsar, and Ferozepur.

Table 2.5: Evolution of Milk Production in Punjab by District, 1996–2004

('000 tons)

Zone	1996	2000	2004	% change (1996–2004)
North-east	1,413	1,361	1,709	20.95
Central	3,89	4,470	4,803	26.76
South-west	1,502	1,893	1,996	32.89
TOTAL	6,704	7,724	8,508	26.91

Source:

2.3.3 Traditional Commodities

Wheat and rice, especially the latter, have driven traditional commodities away from the Punjab landscape. However, if the fortunes of wheat and rice weaken, several of these commodities, all less water using than rice, could again rise in importance.

Cotton has retained a niche in the canal-irrigated south-west region. Historically, the crop has been subject to fluctuations in both prices and production. In the last few

[1] Survey results, admittedly from limited samples, reported in Table 2.12, suggest higher employment requirements.

years, insect problems have intensified and chemicals have become more expensive. However, it appears that new pest-resistant Bt varieties have achieved success in Punjab, similar to the experience in Gujarat. During 2005–06, production of cotton in Punjab increased to 2.35 million bales from 1.5 million bales in 2003–04 (Chawla 2006). There are reports of cotton exports to Pakistan for the first time through the Wagah Border. Although it might be difficult to assert that these recent trends in cotton have resulted in a gradual shift from the rice–wheat cropping system, increased production and high price are incentives for the farmers to do so.

Sugar cane is another alternative to rice–wheat cropping. Institutional and policy factors such as licensing of sugar factories in favor of cooperatives may have been the cause of limited profitability of sugar cane farming in Punjab in the past. New privately-financed factories would have to be established to make the crop important again. The delicensing of sugar mills in 2002 has provided a fillip to private sector sugar factories and the state should take advantage of it, and promote sugar cane cultivation. The delicensing mechanism will be useful in investing in integrated structures comprising of mills and distilleries.

Pulses have literally fallen off the agricultural map in Punjab. However, prices are high and new higher-yielding varieties of pigeonpeas (short-duration pigeonpea) developed by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) hold potential for the future. Water-efficient varieties of pigeonpeas could play an important role in reversing the process of soil degradation and conserving groundwater. Introduction of legumes in the rice–wheat cropping system can be an effective diversification from the conventional rice–wheat cropping system owing to its low water requirement for growth and high fuelwood yield as well as enhancing soil fertility. In a pigeonpea–wheat system, wheat requires less nitrogen fertilizer and gives better yields (Singh and Dwivedi 2006). Minimum support prices through effective procurement could provide incentive for the farmers to introduce more legumes in their rice–wheat cropping cycles.

Institutional factors, particularly weak marketing linkages, explain the relative absence of poultry Punjab. However, the bigger players in South India have indicated interest in moving to North India and exploiting Punjab, Delhi, and other big poultry-consuming markets. For instance, Suguna Poultry Farm Ltd, the flagship arm of the Coimbatore based Suguna Group, is foraying in the northern market with an investment of Rs 1.2 billion over the two years 2007 and 2008 and has started operations in Punjab (*Business Line* 2006). With more poultry, maize for feed [particularly, quality protein maize (QPM)] would become a more produce.

Fodder, a particularly low consumer of water, is key to higher dairy production. QPM, developed by the Centro Internacional de Mejoramiento de Maíz y Trigo **(**International Maize and Wheat Improvement Center) (CIMMYT) in the 1980s and also worked upon by the Indian Council of Agricultural Research (ICAR), has the potential to increase both productivity of the crop and profitability to the growers. It is a high value cereal grain in terms of its superior nutritional quality and is used as feed and fodder for poultry and livestock. If poultry farming gains its stature in Punjab, there will be a substantial increase in the demand for maize as fodder. The use of QPM will result in early maturity of broilers, and save energy and feed as well as additional costs incurred in fortifying fodder with lysins and tryptophan. [2]

Durum wheat and organic rice (for which contract farming is very promising and there is a large market) are other options. There are examples where contract farming in organic rice has been successful compared to basmati and other varieties of rice. At present, durum wheat comprises of a small proportion (5–12 percent) of the total wheat grown in India (USDA 2005). It is primarily grown in the central zone, which includes Madhya Pradesh, Gujarat, parts of Punjab, south Rajasthan, and Maharashtra. Both durum wheat and organic rice contract farming in India have the potential to fetch better income for the farmers as well as the processors. There exists a potential export market for organic rice, and at present the crop faces a supply constraint. Developing appropriate R&D together with extension services to disseminate information could provide the right incentives for farmers to undertake organic cultivation. Globally accepted certification will be a prerequisite to enable capturing of the niche market for these organic products. Adoption of these high-yielding varieties could shift the production frontier and enable the country to compete to meet the global demand for these commodities. With the aim of harnessing the potential of organic farming, the Punjab government has set up the Organic Farming Council, and more than 1,200 farmers with nearly 7,200 acres of land have already been registered with it (*Hindu*, January 12, 2006). In China, the area under hybrid rice was about 15 million ha in 2004 (and accounted for 50 percent of the total rice area in 1995) while in India it was only 0.2 million ha in 2001–02 (www.fao.org/rice2004/).

Thus, there exist a number of traditional commodities that could potentially re-enter the production scene, providing incomes and improving pressure on the water table.

[2] See Rice–Wheat Consortium for the Indo-Gangetic Plains website http://www.rwc.cgiar.org/pubs/157/QPMaize_lowres.pdf.

2.4 Economics of High-value Commodities in Punjab

Wheat and rice are currently grown on large acreages under extremely favorable conditions. In contrast, high-value commodities are currently grown on limited acreages under much less favorable conditions. The marketing infrastructure and services and government foodgrains management (regarding price and procurement) clearly favor foodgrains. This gives rise to the question of whether HVCs can compete with wheat and rice for the farmer's land area.

2.4.1 Profitability

It is clear, first, that farmers today perceive wheat and rice to be their most profitable alternatives. This observation can be inferred from the farmers devoting practically all available land, mostly irrigated, to growing wheat and rice (see Table 1.2).

Calculations of relative profitability confirm that wheat and rice are clearly more remunerative than the traditional alternatives (see Table 2.6). The two exceptions are sugar cane and cotton. Sugar cane is an annual crop that is both planted and ratooned. Sugar cane and cotton have niches in the canal-irrigated areas of the sandy south-western region.

.

Table 2.6: Gross Returns and Variable Costs in Wheat, Rice, and Alternative Traditional Crops (per ha), 1999–2000

Crop	Gross returns per ha (Rs)	Variable costs per ha (Rs)	Return over variable costs per ha (Rs)
Rabi			
Wheat	31,729	12,338	19,390
Barley	18,524	8,607	9,917
Gram	12,601	5,709	6,892
Kharif			
Rice	26,107	12,474	13,633
Maize	15,269	9,873	5,396
Groundnuts	12,710	7,803	4,907
Cotton (Desi and American)	15,708–17,508	5,650–6,403	9,305–11,858
Sugar cane	66,566	51,118	15,447

Source: Singh and Dhaliwal (2002).

Third, vegetable crops generally yield higher returns than traditional field crops (see Table 2.7). However, their areas and production are limited. Under current conditions, production and prices are highly variable—the former due to insects, diseases, and climatic conditions and the latter due to traditional marketing channels, perishability,

and market glut—and capital costs are high. Therefore, superior management is required to achieve high returns.

Table 2.7: Gross Returns and Variable Costs in Vegetable Crops (per ha), 1999–2000

(in Rs)

Crop	Gross returns	Variable costs	Return over variable costs
Bhindi	29,600	18,849	10,751
Brinjal	53,914	24,507	29,408
Chilies	55,650	27,557	28,093
Potato	43,750	32,746	11,004
Cauliflower	95,600	55,025	40,575
Cabbage	56,000	44,682	11,318
Onion	68,250	28,991	39,259
Peas	35,400	20,182	15,218
Tomato	43,380	27,695	15,685

Source: Singh and Dhaliwal (2002).

Orchards typically are long-duration enterprises. Usually, several years pass by before production can begin and fruit crops often occupy the land yearlong. Singh and Dhaliwal (2002) calculated annualized returns of Rs 27,015 for kinnow and Rs 21,295 for mangos. However, returns were found to be very unstable due to market fluctuations, location of the farm, and availability of farm resources during the life of the orchard. Though calculated returns for sweet oranges for juices are not available, PAIC has committed a large amount of money to the cultivation of sweet oranges with the expectation that this will be a very remunerable enterprise for Punjab farmers in the future. PepsiCo and PAIC has also set up a 9,600 sq. ft greenhouse at the Agriculture Research and Development Centre at Jalandhar to commercialize citrus cultivation in the state.[3]

Among fruits, kinnow has gained in popularity in Punjab. The fruit has a four-year gestation period (presumably when there can be some returns from intercropping), after which there is a gradual increase in production over the next five years before full production is achieved from year 10 onward for 2–3 months of the year. Wheat or rice may or may not be intercropping of during the gestation period. Kinnow may be

[3] See India Brand Equity Foundation website www.ibef.org/dpownload/Punjab_may06.pdf, accessed May 2006.

sold for fresh fruit (for which the market may be relatively limited) or processed for juice (for domestic consumption or export). Figures for kinnows are for those sold as fruit in distant markets away from the production sites, at times in neighbouring states. For locally marketed kinnows, the returns per ha in 2003–04 were Rs 238,839 and the total returns over variable costs was 7.51. These figures may be on the higher side. ANZDEC Ltd, in a study for the Asian Development Bank (ADB), calculated a gestation period of four years with no production, production gradually increasing over the next six years, and continuing peak production from year 10 onward. Net returns were found to be negative over the first five years, then gradually increasing to Rs 77,913 annually from year 10 onward (ANZDEC 2005).

For this study, returns for kinnow were computed and then compared with the rice–wheat system under several assumptions. The present values of kinnow versus rice–wheat production were computed by assuming: (i) life span of 17 years; and (ii) 5 percent discounted rate. The analysis was done under three scenarios: (i) no wheat intercropping during the initial three years; (ii) wheat intercropping during the initial four years,[4] and (iii) kinnow is waxed and sold at higher prices (see Table 2.9). Kinnow has a marginal edge over rice–wheat production in case wheat is intercropped during the initial years. Since kinnow can be grown on less favorable land than wheat (for example, the quality of irrigation is not as sensitive), the differences may be even greater. It is important to note that the present value of kinnow production is much higher if it is sold for fruit after waxing—an approach of value addition.

While calculations by Singh and Dhaliwal (2002) do not indicate that fodder crops have very high returns, the special circumstances of these crops is in their favor. These crops are often short-season and can be fitted into rotations between wheat and rice when land, labor, and machinery are not employed. Generally the fodder crops are fed to animals reared within the farm enterprise; therefore, marketing costs are not incurred.

In spite of proximity to the Delhi market, poultry is still a limited enterprise in Punjab. If this were to develop, maize grown for feed could become a more attractive commodity. The calculation of returns to poultry by Singh and Dhaliwal (2002) suggests potentially high returns but also emphasizes the high capital costs and the need to establish stable marketing arrangements. Poultry has become very attractive in Andhra Pradesh where contract farming is well established.

[4] It is the general practice by the farmers.

The World Bank (2003) calculated returns from PAU enterprise budgets with the full package of technology for a range of crops and dairy. It found that in the *kharif* season, cotton and basmati rice, and in the *rabi* season, winter maize and gram could compete with rice and wheat. Potato (gross profits of Rs 23,983 per ha), tomato (Rs 33,612 per ha), mentha (Rs 26,374 per ha), and dairy (Rs 56,104 per ha) were found to be very competitive with rice (Rs 17,508 per ha) and wheat (Rs 21,810 per ha). Dairy returns reflected income from milk yields of eight milch animals for a year. The calculations, however, do not take into account the lower price risk and yield risk of rice and wheat.

In order to supplement the available information, and in particular, get information on contract farming, we carried out surveys and calculated partial budgets for selected alternative high-value crops to determine net returns and total-returns over variable costs ratios for the 2003–04 cropping year. The samples were relatively small. The results capture only one production year. Nevertheless, the analysis provides insights into the potential benefits.

With the exception of chilies, high-value horticultural crops were found to have higher per-acre net returns than rice and wheat (see Table 2.8). In particular, onions and dairy were especially lucrative during 2003–04. Land use for dairying was taken as the land put under fodder production to meet green fodder requirements and was 4.0 acres (1.62 ha) in the case of Nestle integrated dairy units consisting of 10 milch animals. Viewed from another perspective, only onions had a higher ratio of total returns divided by variable costs than wheat and paddy during this period (see Table 2.8), implying that traditional crops still provide a better return to variable investments, and hence are less risky, than high-value crops.

Table 2.8: Profitability of Rice, Wheat, and Alternative High-value Crops, 2003–04

Crop	Net returns (Rs)	Total returns over variable costs	Crop duration (months)
	Wheat and rice (per ha)		
Wheat	19,857	2.61	6–7
Paddy	19,509	2.19	5
	Alternative high-value vegetables (per ha)		
Potato	33,195	1.73	3–5
Tomato	27,183	1.75	5–6
Onion	104,177	3.36	7

Chilies	14,305	1.37	6
Cauliflower	25,550	1.86	4–5
Green Peas	41,762	2.03	5
	Fruits (after maturity)		
Kinnow	283,359	2.06*	12
	Dairy (farm enterprise)		
Dairy (Nestle)	151,490	1.32	NA

Source: Primary survey conducted in 2005.

Table 2.9: Net Present Value of Kinnow Production under Different Scenarios Compared with Rice–Wheat Production

Item	Net present value (Rs per ha)
Sole kinnow crop	385,065
Kinnow intercropped with wheat	457,223
Kinnow waxed and intercropped with wheat	1,331,664
Rice–wheat system	449,835

Source: Authors' calculations.

2.4.2 Volatility of Production and Prices

Wheat and rice have experienced relatively small variations around growth trends. In contrast, the variation in yields in high-value crops has been much higher. [5]

High value commodities, particularly fruits and vegetables, are prone to pest attacks, resulting in crop failures. These crops are more susceptible to extreme weather conditions and involve a lot of sophisticated production techniques to reap superior quality produce. Small farmers or farmers with limited access to technology and information are susceptible to such production shocks, which acts as a disincentive to come out of the rice–wheat spiral.

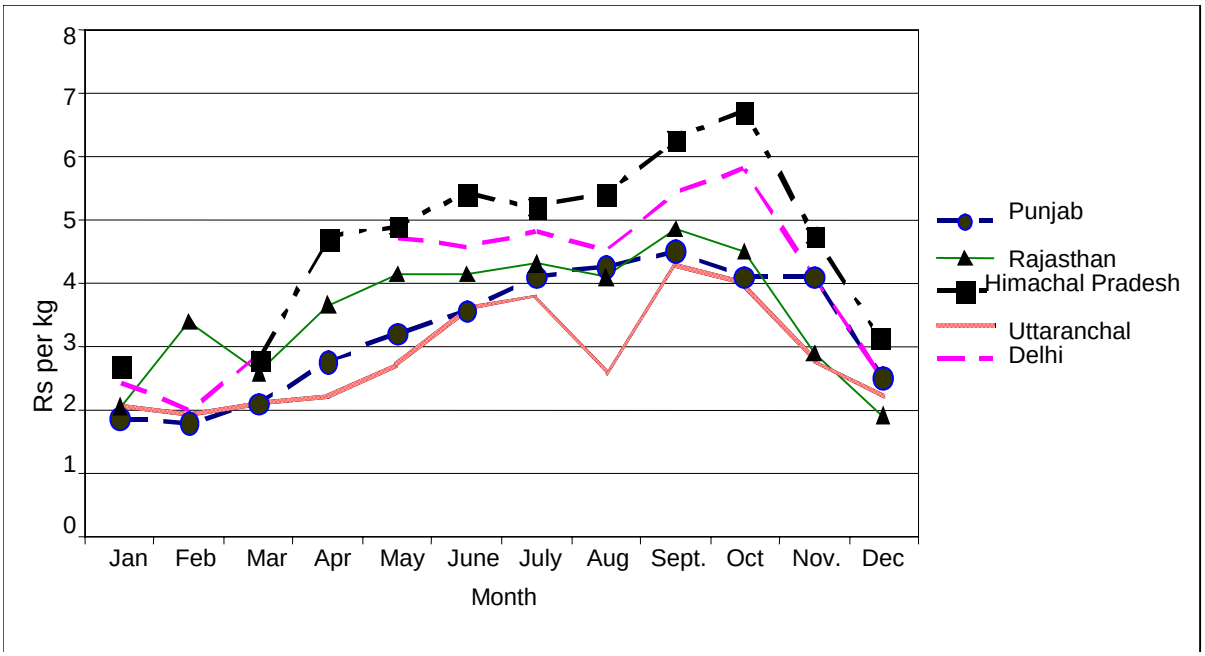
High-value crops face large and recurrent price fluctuations. Volatility of prices, as measured by the coefficient of variation, was much higher for horticultural products (ranging from a low of 18 percent for capsicum to a high of 30 percent for kinnows) than for rice and wheat (2.5 percent and 4.5 percent, respectively) in the year 2005, i.e. the year of the primary survey. [6]

[5] Admittedly, this statement is an assertion. High-value commodities, particularly rice and wheat, are prone to production risk and price shocks. Time series data on yields for fruits and vegetables are unreliable and thus calculations of production variability have not been attempted.
[6] Calculated using data from Government of Punjab, *Statistical Abstract of Punjab*, various years.

Horticultural products tend to be seasonal, with different regions in India cultivating produce at different times of the year. As a consequence, the competitiveness of high-value horticultural production from Punjab in the domestic markets is seasonally conditioned.

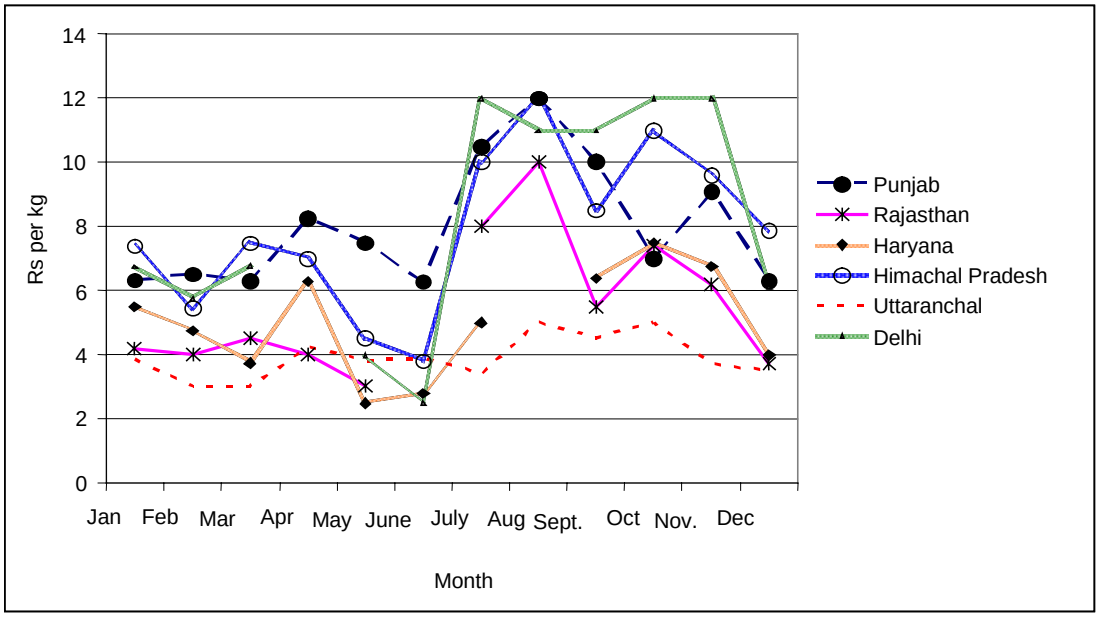
In the case of potatoes (see Figure 2.1), prices in nearby markets generally track each other, though the magnitudes of price fluctuations differ markedly, most notably in Himachal Pradesh and Delhi. Wholesale prices of potatoes in Punjab vary from a low of less than Rs 2 per kg to a high of approximately Rs 4.5 per kg. Wholesale potato prices in Punjab remained lower than those in Himachal Pradesh and are lower or the same as those prevailing in Delhi. However, transportation costs between Punjab and Delhi limit the competitiveness of Punjabi potatoes in Delhi during those months when prices are similar (for example, November through February). Wholesale prices for tomatoes (see Figure 2.2) are quite variable over the year, with significant variation reported in Punjab, Delhi, and Himachal Pradesh, particularly after June, while wholesale prices are relatively stable in Uttaranchal.

Figure 2.1: Seasonality of Potato Prices in Selected Markets, 2004



Source: Agricultural Marketing Network website http://www.agmark.nic.in, accessed January 15, 2006.

Figure 2.2: Seasonality of Tomato Prices in Selected Markets, 2004



Source: Agricultural Marketing Network website http://www.agmark.nic.in, accessed January 15, 2006.

The variability demonstrated in Figures 2.1 and 2.2 is accentuated when considering a longer time horizon. Seasonal variability across years varies markedly. For instance, in potatoes, across-year variability increases every third year or so, befitting the cobweb cycle of prices.[7] Moreover, the year-to-year magnitude of seasonal price changes differs considerably by market and by variety.

Discussion with traders and farmers during the survey revealed a wide fluctuation in the prices of vegetables compared to prices of rice and wheat. Since the survey results during the study period captured only one production year, sensitivity analysis was done to examine the implications of fluctuating prices on profitability. The analysis was carried out at (i) average prices that farmers received during the study period; (ii) average prices reduced by 25 percent; (ii) average prices reduced by 50 percent; and (iv) threshold prices that equate profitability of selected vegetables with wheat or rice (see Table 2.10).

[7] The annual coefficient of variation of wholesale potato prices in selected markets in 1996–2003, compiled from Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India website http://agricoop.nic.in/farmprices/comoni.htm

Table 2.10: Per Hectare Net Profit of Selected Vegetables in Punjab under Different Price Scenarios, 2003–04

Crop	Net profit (Rs per ha)			Price level for threshold wheat profit (Rs per quintal)
	Average prices	Prices fall by 25%	Prices fall by 50%	
Onion	194,177	67,312	30,481	177.7 (-57.22)*
Cauliflower	25,550	11,802	-2,034	203.98 (-10.45)
Potato	25,372	9,329	-6,698	288.71 (-8.57)
Green pea	35,393	16,386	-2,607	425.70 (-20.43)
Chilies	14,393	900	-12,590	757.82 (+10.12)
Tomato	22,074	8,011	-6,051	143.93 (-4.05)

Note: * Figures in parentheses are the percentage deviation from the average prices. Wheat net profit is Rs 19,857 per ha.
Source: Primary survey conducted in 2005.

Except onions, none of the vegetables could compete with wheat in case prices fell by 25 percent. Also, except for onions, the returns were negative in case prices fell by half of the average prices. Onion production continued to be more profitable than rice even if prices fell by half of the average prices (onion production can be at par with rice profit even if its prices were to fall by as high as 57 percent). In relation to wheat, green peas, however, were found to be competitive only until prices fall by 21 percent, cauliflower until a 10.5 percent fall, and potato until 8.5 percent fall in price. For tomato, if prices fell by more than 5 percent, the crop would not be competitive with rice.

Looking at all the sources of volatility, high-value commodities are perceived as 'riskier' alternatives. Any fall in prices due to a marginal increase in the supply of vegetables affects their profitability adversely. Volatility in prices (and production) is a major factor constraining the expansion of vegetables in Punjab.

2.4.3 Farmer's Share of Consumer's Price

A significant portion of the final consumer price accrues to intermediaries in the supply chain such as wholesalers and retailers. For example, producers typically received less than half the consumer price for their produce in 2001 (see Table 2.11),

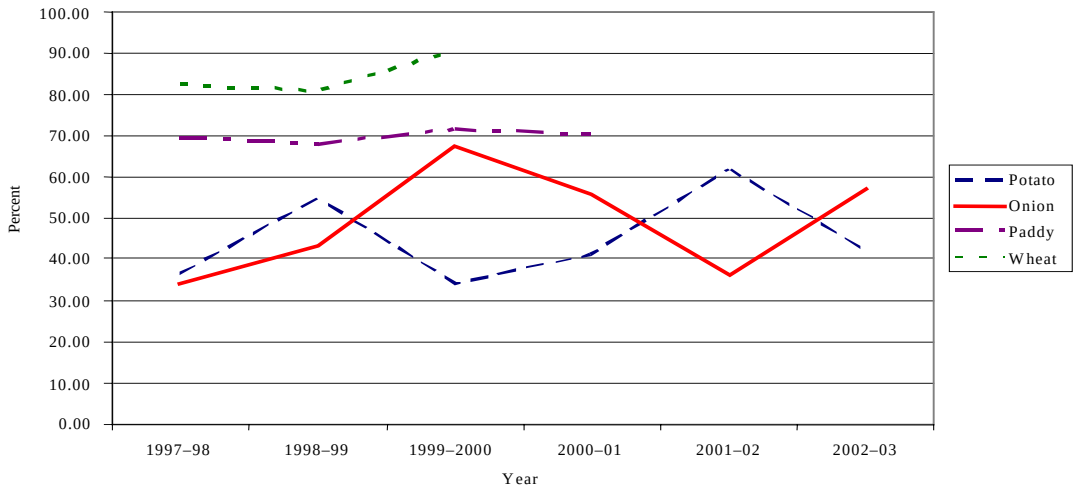
which suggests that the long supply chains present in traditional market channels lead to a reduction in the profits going to primary producers. More recent data from the Ministry of Agriculture reveal significant variability across seasons in the share of consumer price accruing to farmers in the case of potatoes and onions (see Figure 2.3). For onions, farmers received less than 40 percent of the consumer price in 1997–98, but over 60 percent two years later. However, this share fell back to under 40 percent after another two years. Similar fluctuations arise in the potato market.

Table 2.11: Share of Cost and Margin of Producer, Wholesaler, and Retailer in in Consumer Price for Vegetables in Punjab

	Potato	Green peas	Tomato	Green chili
Consumer price (Rs per quintal)	229.8	580	460.6	798.8
Percentage share received by:				
Cost of producer (input providers)	9	3.5	5.1	3.3
Margin of producer	34.6	59.6	47.8	39.6
Cost of wholesaler and retailer	24.9	7.2	20.7	17.5
Margin of wholesaler and retailer	31.6	29.7	26.5	39.6
Consumer price	100	100	100	100

Source: Singh and Chahal (2001).

Figure 2.3: Share of Retail Price Accruing to Farmers for Various Crops in Punjab, 1997–98 to 2002–03



Source: Website of Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India http://agricoop.nic.in/farmprices, accessed January 15, 2006; Government of India, *Agricultural Prices in India*, various years; Government of Punjab, *Statistical Abstract of Punjab*, various years;

By contrast, the share of the consumer price for wheat and paddy is relatively stable and high, with paddy producers obtaining about 70 percent of the consumer price and wheat producers receiving well over 80 percent. This suggests that high, controlled support prices for rice and wheat have served not only to stabilize the income received by grain farmers, but also the share of value received.

2.4.4 Post-harvest Losses

The limited development of infrastructure, such as cold storage, processing, and marketing, contributes to increased post-harvest losses, which reduce the producers' profitability. The World Bank (2005) reported average losses of 12 percent for horticultural products throughout the value chain, including 8 percent between the farm and *mandi*, 2 percent within the district, and 1 percent each within and externally from the state. Post-harvest losses as high as 15–20 percent have also been estimated (Dhatt and Ghuman 2000).

2.4.5 Transportation Costs

The state of Punjab has a high marketing density for foodgrains; most villages are located within 10 miles from a market. In contrast, markets for high-value commodities are and scattered widely across the state. The costs to transport high-value commodities to potential markets can be considerable.

High freight costs pose a constraint to the exploitation of export markets. While subsidies for domestic transportation reduce the actual freight charges, the landed cost of Indian horticultural products is often significantly higher than imports from other sources, even when there are such subsidies (see Appendix Table A2.2). The f.o.b. export price for Indian horticulture is much lower than the import unit values in such high-value markets, which suggests that improvements in freight costs could stimulate exports overseas.

2.4.6 Employment, Tractor Usage, and Water Usage

Secondary information of the amount of water usage (proxied by the number of irrigations, i.e. number of times a crop is irrigated), tractor usage, and man-hours of employment was obtained to assess the resources necessary to engage in alternate uses (see Table 2.12).

Table 2.12: Input Requirements for Rice, Wheat, and Alternative High-Value Crops in Punjab, 2003–04

Crop	Crop duration (months)	Irrigations (number)	Tractor usage (hours)	Employment (man-hours) *
		Wheat and rice (per ha)		
Wheat	6–7	12	17	178
Paddy	5	49	49	630
		Alternative high-value vegetables (per ha)		
Potato	3–5	12	72	912
Tomato	5–6	25	49	3,015
Onion	7	12	52	3,190
Chilies	6	20	25	3,180
Cauliflower	4–5	12.5–20	NA	NA
Green peas	5	5–7.5	NA	NA
		Dairy (farm enterprise)		
Dairy (Nestle)	NA**	NA	NA	651***

Notes: *The employment data reflected one production season and a limited number of enterprises. The Punjab Agricultural University has estimated employment of 143 person days per ha per year for wheat, 143 for maize, 460 for guava, 560 for sweet oranges, 560 for mango, 750 for kinnow, and 2,510 for grapes (reported in ANZDEC 2005).
**4 acres of fodder;
***Refers to man-days.
Source: Primary survey conducted in 2005.

As compared to the rice–wheat system, tomatoes, onions, and chilies are more labor-intensive, with these crops requiring about five times the amount of labor compared to paddy and even more compared to wheat. The labor requirement in dairy production is especially high. In high-value commodities, a high proportion of labor by women was reported. The higher total labor requirements, while auguring well for employment prospects and especially for productively utilizing the women, may be an ultimate constraint in relatively labor-constrained and high-wage Punjab.

All the sampled high-valued crops use less water than paddy.

Tractor usage varies across crops but is roughly consistent with its use in paddy cultivation.

2.4.7 Challenges and Opportunities

It must be emphasized that it is the farmers' perception that ultimately determines acreage allocations. There is no question that under the current condition of assured markets with high, guaranteed prices, wheat and rice dominate the acreage. However, there is evidence that, in spite of the high, guaranteed prices, returns from wheat and rice, especially the latter, have been declining over time (World Bank 2003c). Given the demand and environmental constraints, unless the MSP continues to rise, even over world prices, returns to wheat and rice are anticipated to decline further. Further, given the demand changes and the new marketing arrangements rapidly unfolding (as described later), the prospects for alternative crops can only improve.

Numerous stakeholders have cited marketing constraints as a key factor limiting agricultural diversification. High-value commodities face problems of relatively small quantities, high transactions costs, high perishability, and high price and production risks. In the absence of storage, crop insurance, and other forms of infrastructure that mitigate risk and dampen the seasonality of production and favorable prices, small farmers in particular are subject to seasonal boom and bust cycles in production and prices, which discourages diversification, particularly when alternatives such as rice and wheat have a guaranteed market from government purchases.

Thus, with production and prices highly variable, the percentage of consumer price going to the farmer being low, and high losses, the farmer faces significant risks in making the transition from wheat and rice to high-value commodities. New institutional arrangements, including contract farming and cooperatives, are a response to those challenges. Greater transparency in contracts, better information, and lower production and price volatility are key to moving forward. Who—agribusiness or farmers or both—will take the first step remains to be seen.

2.5 Contract Farming

Contract farming is not new to Punjab. The state had set out a target to bring 0.3 million acres of land under contract farming during the financial year 2006–07 and release 33 percent area from paddy and wheat to citrus, horticulture, viticulture, and organic farming.[8] Sugar mills have long used contracts with sugar cane growers to procure specific quantities of sugar cane at pre-agreed prices. Likewise, milk plants also contract for milk supplies. Informal contracts between producers of fruits and

[8]Government of Punjab website www.punjabgovt.nic.in, accessed March 25, 2006.

vegetables and private traders to engage in the picking, grading, packing, transportation, and marketing of produce have traditionally been prevalent.

Recently, contract farming has been promoted by the Punjab Agro Foodgrain Corporation (PAFC) to encourage agricultural diversification into alternative crops. Particular areas in which contract farming has become popular in Punjab include basmati rice, kinnow fruits, vegetables (potato, tomato, chili, and green peas), rapeseed and mustard, sunflower, hyola, winter maize, and milk. There are two main forms of contract farming for horticultural commodities in Punjab—processing-industry driven and government promoted.

2.5.1 Processing Industry Driven Contract Farming Approach

The most important and widespread model of contract farming is driven by private processors and associated with the production of fruits and vegetables. In this model, a processing firm enters into a contract with growers to regularly supply raw materials of a desired quality to the plant. Two examples of this model include PepsiCo for potatoes (see Box 2.1) and Nijjer Foods Ltd. for tomatoes and chilies. In both cases, the companies supply seeds and seedlings for specific varieties mandated by the companies and supervise and monitor their production throughout the growing season. The firms further provide technical advice to farmers. Purchasing decisions vary by company in terms of the amount and quality of products that are accepted. For instance, PepsiCo applies stringent quality standards in their procurement, which is prescribed in the contract. By contrast, Nijjer Foods accepts all production that is brought to the factory and cleans the products at the factory gate to ensure that aflatoxin levels are low. In both cases, farmers are required to bring the produce to the factory, but transportation costs are adjusted in the contracted price. While the contract is written and signed by both parties, it is not strictly speaking a legal document.

Box 2.1: The Origins of Contract Farming in Punjab: The Case of PepsiCo

The model of contract farming in perishables in Punjab started with PepsiCo in 1989, which began entering into contractual relationships with farmers to produce potatoes and tomatoes. PepsiCo was allowed to enter the Indian market for its soft drinks business on the condition that it also engaged in the processing of fruits and vegetables and established linkages with farmers. PepsiCo remained in Punjab for over a decade and successfully utilized contract farming to supply its processing plants. However, in 2001, PepsiCo sold its tomato processing facility to Hindustan Lever Ltd. (HLL). It re-acquired the facility shortly afterwards, but completely disbanded production by 2004–05.

At the start, PepsiCo contracted about 35 farmers with 150 acres, all within a 30 km radius cluster. By 1994, the number of contract farmers had risen to 350, spread over 2,700 acres, which later increased to 600 farmers, some of whom were on farms as far away as 350 km from the processing plant. The distance involved was necessary in order that the harvesting season could be spread and staggered for two months. Initially (in 1990), the raw material price cost Rs 4.5 per kg but fell to Rs 1.85 per kg by 2000.

PepsiCo established a research and development unit at a farm that focused on developing hybrid varieties for processing, improving agronomic practices, designing or introducing farm implements concerned with planting, harvesting, and cultivating, and using the farm as a farmer demonstration unit. Farmer field evaluations were carried out in many locations in an effort to look at variety adaptation and for season extension. The company also set up a nursery to provide uniform planting material at the right time to effectively schedule the production of the raw material.

PepsiCo's departure from the market was due to a number of factors. Poor profitability of the plant due to difficulties in obtaining year-round supplies of raw material from Punjab has been cited as one factor. Another is competition with subsidized imports of tomato paste from China. Indeed, data from FAO suggest that the productivity of tomatoes in China is significantly higher than in India—between 1997 and 2005, yields in China were in the range of 24–28 tons per ha, while those in India were 14–18 tons per ha. Production levels in China are also over four times higher than in India (32 million tons in 2005 compared to just under 8 million tons in India). Trade data from UN Comtrade show a surge in tomato paste imports in 1998 (though only a third or so was from China) and a slowdown during 1999–2001. However, since 2002, imports of tomato paste have increased significantly, of which a majority was from China. This has occurred despite relatively high applied tariffs on tomato paste of 40 percent *ad valorem* according to the Agricultural Market Access Database (AMAD) of the Economic Research Service (ERS) of the United States Department of Agriculture (USDA) (latest figure is for 1997). Transportation costs from Punjab to international ports were also prohibitive. Other informant interviews conducted in

January 2006 revealed that a major problem with the PepsiCo program was the practice of offering a fixed price to farmers, which encouraged side-selling when market prices were higher than the contracted price. One interviewee mentioned that the varieties introduced by PepsiCo mistimed the market and were harvested in advance of the normal harvest and at a time when market prices were higher than the contract price.

Despite its problems in tomato production, PepsiCo maintains contract farming arrangements to supply its potato chip processing unit in the district of Sangrur. It is also promoting citrus production as a source of raw material for its planned Tropicana juice facility.

PepsiCo India is all set to start its citrus cultivation project in Punjab under different models of contract farming. In mid 2006, the group announced its plan to start off with 50,000 acres under citrus and go up to 1 million by 2015. In 2006, 2,000 acres were planted with sweet oranges and PepsiCo wants to replicate the success it achieved with tomatoes for the Tropicana fruit juice brand. The R&D centre at Jallowal has the capacity to grow around 100,000 to 4 million plants.

Source: Presentation by Abhiram Seth, Executive Director, PepsiCo. India at the Rural Marketing Summit, October 7–8, 2005; Singh (2005); Sehgal (2005); Informant interviews in Punjab, January 2006; India Agribusiness Development Support Project, ANZDEC, 2005; *Business Line*, Tuesday, June 20, 2006.

In a third example, FieldFresh Foods (P) Limited (FFL) leases land to grow vegetables, initially for export (see Box 2.2).

Box 2.2: The FieldFresh Foods (P) Limited Model of Contract Farming

FieldFresh Foods (P) Limited (FFL) is a joint venture between the Bharti Group and Rothschild group of the United Kingdom, with each group holding an equal equity share. FFL aims to access international markets for produce (bitter gourd, okra, baby corn, and snow peas) by creating linkages with farmers through contracts and encouraging state-of-the-art cultivation practices. In Punjab, FFL leases land from farmers (at a rate of Rs 12,000–15,000 per year) to devote to production earmarked for FFL. In other states, FFL contracts with small farmers to deliver production to FFL. A 300-acre model farm (called the FieldFresh Agriculture Center of Excellence) was established near Ludhiana in Ladowal with facilities to promote precision farming and provide demonstration sessions to farmers. The company has also started operations in Uttaranchal and Rajasthan to ensure year-round supply of vegetables to enhance its off-season advantages in different international markets.

The company plans to have 2,000 acres under cultivation by 2006 and an additional 1,000 acres by 2007. In total, FFL will contract with around 8,000–10,000 farmers. FFL projects an initial project outlay of Rs 50 million in the first phase that is allocated towards the creation of infrastructure facilities for R&D, processing, and cold storage. FFL has also entered into strategic partnerships with large multinationals, such as Snowman of Japan for strengthening its cold chain infrastructure.

The company views its capability of supplying produce year-round as a major strength. This ability is predicated on the construction and utilization of state-of-the-art facilities for protected cultivation and using the latest in agricultural technology to enhance productivity.

Despite the grand plans of FFL, the initial experience with its export consignments (including fruits) has not yet been very promising. FFL has been able to send around 30–40 consignments of okra, mushrooms, grapes, mangoes, litchis, and pomegranates (among others). However, a number of these shipments have failed to meet quality specifications at their export destination. Nonetheless, FFL has continued with its model and aims to earn returns of US$ 1 million in 2006.

Recent reports suggest that the group has leased in around 4,200 acres of land spanning 78 farms in three districts in Punjab, viz. Fatehgarh, Sangrur, and Jalandhar. Bharti's tie-up with the US retail giant Wal-Mart will definitely generate resources and infrastructure necessary to make contract farming more remunerative for the farmers.

Source: Singh (2005); Interviews with FieldFresh Foods Pvt. Ltd., January 19, 2006; Eliot (2006).

A slight variation in this model involves contract farming facilitated by PAIC through joint ventures with private companies. In this model, the PAIC acts as a facilitator and broker in the joint venture company through equity participation. It also procures some of the commodities. Appendix Table A2.3 lists some of the projects that have been facilitated by PAIC. For example, PAIC procures green peas grown in the district of Patiala for local processors. In this case, farmers grow PAU-recommended varieties that are procured by the processing unit. Pea processors do not provide any inputs or technical advice to the farmers, however. The processing unit grades the produce and rejects those not conforming to their prescribed specifications and standards in terms of maturity and size of the pods. As with the pure private-sector model, the contract is written, but is not legally binding. Prices are fixed based on the market prices for green peas that prevailed in surrounding markets over the last 3–4 years.

2.5.2 Government-promoted Contract Farming

In the second model of contract farming practised, the Government of Punjab directly acts as a facilitator in the contracting process. The government launched contract farming in a number of non-rice/wheat crops, such as maize, barley, sunflower, hyola, basmati rice, etc. in 2003. The basic philosophy of this program is that contract farming is needed to mitigate price fluctuations and the underdeveloped marketing infrastructure for high-value commodities. Contracts were entered into with farmers of targeted crops at contracted prices that were generally lower than market prices and deemed as 'comfort prices'. Contracts were open-ended for farmers, as farmers were free to sell their produce in the open market if the market price was higher than the comfort price. Examples of companies that entered into this type of contract arrangement with farmers include Advanta for sunflower; PAFC for hyola; Pro-Agro Hyderabad and Mahindra Shubh Labh for winter maize; United Beverages for barley; and Rallis India Ltd., Mahindra Shubhlabh Services Ltd., Escorts Group, and DCM Shriram for basmati rice.

The companies involved in these contracts supply their own seeds to the farmers and provide technical and extension services to growers. In return for this arrangement, the Government of Punjab reduces the combination of market fees (2 percent), rural development fund charges (2 percent), and infrastructure taxes (1 percent) from a total of 5 percent to zero as a means to promote contract farming. Organizations that wish to engage in direct linkages with farmers without contracts do not receive such exemptions, unless they process wheat or rice. Newly established fruit and vegetable

processors that do not engage in contract farming receive a four-year holiday on such fees.

As in the first model, the contract is written and agreed to by both parties, but is not legally binding (see the Punjab Diversification study for a sample contract). An important characteristic of the contract is that while quality standards are specified, a contracted price is not specified and is left to the discretion of the buyer. Clause 7 of the contract states that '… purchaser will decide the purchase price of crop as per quality specifications. If farmer gets more price of his produce [*sic*] then he is free to sell his produce to the highest bidder/buyer.' While collusive activities are to be regulated by *mandi* boards, evidence from the wheat sector in Haryana shows that collusion among buyers is not uncommon and could depress prices received by farmers (Banerji and Meenakshi 2004). Conversely, buyers are not guaranteed that contracted produce will be sold to them if another buyer in the *mandi* yard offers a higher price. However, buyers that renege on the contract are required to pay any affiliated fees to compensate for any losses encountered when the produce is sold on the open market.

A significant difference between this model and the first model is the involvement of up to four actors in the contracted transaction: farmers, the contracting firm, the marketing firm (contracting with the contracting firm/agency and the Punjab government to buy the produce through contracting agency), and the Punjab government acting as facilitator between the contracting firm, farmers, and the marketing firm/company. In some cases, the functions of the marketing firm were undertaken by the processor.

Procurement (due to a breakdown in the contractual agreement between the farmer and buyer) has been limited to hyola and sunflowers in limited quantities, suggesting that the support mechanism was relatively limited during the 2004–05 crop season. For instance, about 4 percent of hyola was procured, while sunflowers constituted about 20 percent of organized production.

Preliminary evidence from 2003–04 suggests that farmers in these contract farming programs have higher yields than the state average, implying that the programs have made progress in linking farmers with buyers and facilitators to provide higher-quality inputs. The total area under this type of contract farming has rapidly increased from 9,030 ha in 2002–03 to 100,085 ha in 2004–05, with particularly strong growth in *rabi* season crops. The targeted area for 2005–06 was 42,609 ha for the *kharif* season and 70,619 ha in the *rabi* season.

2.5.3 Analysis of Profitability of Horticulture Production: Traditional Channels versus Contract Farming

As noted earlier, surveys of production and marketing of several high-value commodities were carried out during 2004–05. The results capture only one marketing year and thus cannot address the sustainability of contractual relationships over time. Nevertheless, the analysis provides insights into the potential benefits of contract farming.

2.5.3.1 Potatoes

Potatoes are the most commonly grown vegetable in the state and accounted for over 60 percent of the cultivated area of major vegetables in 2004–05. While potatoes are subject to cobweb cycles in production and prices (Singh 2004), there has been a sizeable expansion in area under potatoes over the past several years. Farmers generally plant three crops a year in the following rotation: potato–potato–wheat. In normal years, this rotation is more profitable than the standard rice–wheat rotation.[9] However, the cyclical nature of potato prices implies that the profitability of a potato–potato–wheat rotation is variable. In addition, potato production is relatively capital intensive and requires investments in farm machinery such as potato planters and diggers. Consequently, small farmers in particular tend to avoid potatoes and prefer the more stable rice–wheat rotation, leaving potato cultivation for medium and large farmers.[10]

Potato cultivation under contract farming started in Punjab in 1989 with PepsiCo for it to procure potatoes used in the manufacture of potato chips. The company provides the germplasm, with production taking place under its direct supervision. Quality standards in terms of size, shape, and other parameters are specified in the contract. Produce that does not fulfill those exacting parameters is not accepted. Contracts are renewed every year for almost all contracting farmers, unless farmers break the contract or fail to follow company recommendations on production practices. The incidence of breaking contracts is less than 5 percent.

A comparison of traditional production with that under contract farming reveals that contract farming was more lucrative during 2003–04 (see Table 2.13). The

[9] According to Johl and Ray (2002), returns per ha in a potato–potato–wheat rotation were Rs 9,213 higher than the traditional paddy–wheat rotation.

[10] Indeed, discussions with informants conducted in January 2006 revealed that in Amritsar, five potato farmers each controlled 5,000 acres of land by leasing land from other farmers as a means to increase scale and lower costs. Interview with Nijjer Agro Foods Ltd., January 23, 2006.

productivity of potatoes under contract farming was lower by 5.55 percent than under traditional farming since PepsiCo mainly procures the *Kufri Jyoti* variety that is better suited for processing but is lower yielding than *Kufri badshah*, *Kufri sandhuri*, and other varieties grown by farmers not under contracts. The average total variable cost of cultivation on contract farms was about 36 percent higher than non-contracted producers due to higher costs on seed, grading, packing, transportation, etc. However, favorable prices under contract farming resulted in profits that were almost 62 percent higher than for non-contract farmers, rewarding both farmers and processors for coordinating production accordingly.

Table 2.13: Economics of Production of Selected Crops in Punjab: 2003–04

Cost/Return	Potato (C=25,NC=25)		Tomato (C=20, NC=20)		Green Pea (C=15, NC=15)		Chili (C=20, NC=20)	
	Contract	Non-contract	Contract	Non-contract	Contract	Non-contract	Contract	Non-contract
Total variable cost (Rs per ha)	52,602	38,768	34,176	38,016	40,267	40,608	37,685	39,583
Gross returns (Rs per ha)	93,609	64,150	58,905	67,651	88,383	76,015	51,891	53,986
Net return/Profit* (Rs per ha)	41,006	25,382	24,729	29,635	48,115	35,407	14,206	14,403
Price (Rs per quintal)	546	316	148	197	680	535	600	688
Productivity (quintal per ha)	192	203	398	344	130	142	86	78

Note: C: Number of contract farmers; NC: Number of non-contract farmers; Total variable cost includes seed/nursery, land preparation, sowing, soil covering, fertilizer, pesticide, weeding, spraying, spray charges, irrigation, picking and grading, loading, transport, and other labor charges;
* Net return/profit for potato refers to returns from the produce sold at factory and rejected sold in market.
Source: Primary survey conducted in 2005.

2.5.3.2 Tomatoes

Tomatoes are mainly cultivated in the north-central and south-eastern parts of Punjab. The development of contract farming in tomatoes by PepsiCo (in Jalandhar district) and Nijjer Agro (in Amritsar district) encouraged tomato production in these regions. The harvesting season of tomatoes in Punjab is during May–July and, in a strict sense, does not directly compete with rice. Tomato growers in the sampled farms generally took three crops a year in a tomato–rice–wheat rotation.

While PepsiCo abandoned its contract farming program in tomato, Nijjer Foods Ltd., recently started contracting with tomato and chili farmers in the district of Amritsar. It contracts about 600 ha of tomatoes from producers that are scattered around the processing unit within a radius of about 20–25 kilometers. Nijjer supplies its own genetic material and production technology and established linkages with Nestle India Ltd. to sell tomato ketchup under the brand name of ‘Maggi’. Nijjer Foods provides

seedlings of chilies and tomatoes to farmers to ensure timely sowing of the crop; all other inputs are purchased by the farmer himself. The production practices are monitored by the technical staff of the processing unit. Unlike the case of PepsiCo with potatoes, Nijjer accepts the entire production output of the farmers without any grade or other quality specifications, since the quality of the produce (in terms of solids) for processing is not affected if the tomatoes are slightly over-ripe or damaged; by contrast, these attributes matter for fresh tomatoes. Contract farmers are paid a fixed price, which is agreed to before the planting of the crops. In case the market price rises during the season, the contract price would have to be increased or else sales would be lost to the open market. Relationships created over time encourage the planting of varieties that have higher levels of productivity and reduce transactions costs. Nijjer Agro is considering switching to a 'captive farming' arrangement whereby the company would lease land from the farmers and grow the produce itself.

The sampled tomato farmers in traditional channels realized profits of Rs 29,635 per ha in 2003–04, which was higher than the profitability of paddy, the competing crop, by 52 percent. Moreover, the gross profits for non-contract farmers (returns over variable cost) were higher than for contract farmers by 16.6 percent, largely because the produce sold in the open market fetched higher prices than contracted production. Given that Nijjer Agro would be likely to pay contract farmers a higher price than the existing contracted price to obtain produce for its processing plant, it is anticipated that contract farmers would eventually be more profitable than farmers in traditional channels.

2.5.3.3 Green Peas

The districts of Amritsar, Nawanshahr, Hoshiarpur, and Patiala have emerged as important areas for the cultivation of green peas due to the establishment of a freezing unit. Green peas compete with wheat cultivation and are grown in rotation with rice or other summer vegetables. Contract farming arrangements with green peas started in Punjab in 2003 due to the initiative of PAIC. as a facilitator to arrange a contract between producers and a processing company (Pagro Foods Limited). The contracting model was open-ended, in the sense that if the market price was higher than the contracted price, farmers were free to sell to the open market. The outcome in the first year for green peas was not encouraging, as the produce was not procured by the contracting company on the basis that the quality of the produce was poor even though the seed was supplied by the company. However, during 2004–05 fewer problems were encountered. Recently, a new joint venture (Pagro Foods Limited) with PAIC for

frozen green peas has been set up in Patiala, which may further encourage the cultivation of peas in this area.

The cultivation of green peas for traditional channels generated moderately high profits to farmers of Rs 35,407 per ha, which exceeded the profits of its competing crop (viz. wheat) by 78 percent. The gross profitability of contracted farmers was nearly 36 percent higher than for non-contract farmers, owing to higher prices for contracted farmers (27 percent higher) than for non-contracted farmers. There was no perceptible difference in the total variable cost for either type of farmer. Interestingly, the productivity of contract farmers was lower than that of non-contract farmers.

2.5.3.4 Chilies

Chilies are an important high-value crop in the districts of Amritsar, Jalandhar, and Patiala. Chilies are used in many ways, including in salads, ground spices, chili paste, and paprika. There are two harvesting periods: August–November for the summer crop and November–February for the winter crop. Chilies are typically planted after potatoes or fodder, with a rotation that competes with the rice–wheat system. Contract farming arrangements by Nijjer with chili farmers in Punjab started in 1991 and have expanded through the leasing of land on a long-term basis. Nijjer Agro processes chilies into paste and exports to the EU, USA, and countries in the Persian Gulf. As with tomatoes, the company supplies genetic/varietal material for chilies grown under contract. Imported genetic material is preferred for three reasons: (i) better productivity; (ii) brighter color; and (iii) less bitterness. The use of imported genetic material combined with scientific drying methods have allowed Nijjer Foods to minimize issues related to aflatoxin and high capsaicin (bitterness) that are often encountered in the processing process.

On average, production costs were slightly lower for contract farmers than for non-contract farmers, though the composition of such costs differed markedly. For instance, the cost of nurseries was lower under contract farming as the firm supplied such inputs at cheaper rates to contract growers. On the other hand, fertilizer costs for contract farmers were much higher. Contract farmers realized higher yields than non-contract farmers, but received lower prices. There was significant price variability for chilies in the open market, with prices in the survey period 2003–04 ranging from Rs 500 to Rs 750 per quintal while the contracted price was Rs 600 per quintal. This suggests that contract farming could serve to stabilize incomes better than traditional spot-market sales.

2.5.4 Implications

While the analysis above covers only one marketing year, the results show a mixed picture. Contract farming was seen to be positive for potatoes and green peas and a learning process was seen for tomatoes; Nijjer Agro would be flexible in its payments to obtain the necessary supplies. In the case of chilies, while there was significant price variability in the open market, contract farming has the potential advantage of stabilizing incomes better than traditional spot-market sales. Thus, more conclusive evidence would be needed before a final conclusion on contract farming can be reached.

When contracted prices are out of line with market prices, side-selling and buyers refusing to purchase contracted goods can occur and be problematic. A number of companies such as Nijjer Agro and FieldFresh are moving away from contract farming towards 'captive farming', in which the companies lease land from farmers and control all aspects of production. Captive farming is a move towards full integration to reduce the transactions costs in spot market as well as contract farming types of procurement and meet the more exacting specifications of high-value markets (Williamson 1989). While full integration provides companies with greater control over certain tasks needed to improve the efficiency of production, it also reduces farmer incentives *vis-à-vis* contracts and can be more costly (Reimer 2006). The influence of these competing effects depends on the nature of the industry. Contracting is more likely when farmers and buyers view the importance of investment similarly or when investments are relationship-specific. However, as asymmetry between the investment demands of buyers and farmers rises, full integration tends to be more likely, particularly when food safety, environmental, or traceability demands become increasingly important. The large-scale investments made by private food companies in recent years tentatively suggest that such asymmetries in investment may exist and will fuel a rise in captive farming. Clearly, full integration will have implications on land tenure and the consolidation of landholdings, particularly for smallholders.

2.6 Cooperative Models of Dairy Production

In Punjab, Nestle India Limited and Milkfed together constitute 52 percent of the total milk collected and processed in the organized sector (Dhaliwal 2003). Both groups are involved in promoting milk production by linking milk producers with processing and distribution facilities. However, Nestle India Ltd. has had greater success in promoting milk production in its milkshed area. Both firms collect milk at the farm level.

Milkfed, located in Ludhiana, has milk cooperative societies at the village level, which are managed by the paid secretary of the society, while Nestle India Limited has appointed one of its milk producers as the nodal person who is responsible for the milk collection operations in the village. The number of milk collection centers in a village depends on the volume of milk supplied to the company.

Contract farming is practiced in the procurement of milk, but differs from the forms used for horticultural products. The contract is not a formal (written) contract, but rather an informal commitment between the producer and processor to supply and sell milk. Milk is collected at the village level and prices are determined on daily basis. Cattle feed and veterinary services are provided by the processing units at a subsidized or 'no profit, no loss' basis. The processing units also carry out animal improvement programs through artificial insemination and the provision of quality bulls. Motivation is provided by the company to ensure a smooth supply of milk for processing throughout the year. There are 49 milk plants in the organized sector in Punjab with a processing capacity of 5.55 million liters of milk. The procurement of milk grew at the rate of 4 percent per annum during the 1990s (World Bank 2003c).

2.6.1 Comparative Economics of Milk Production under Different Cooperative Models

By and large, farmers were linked to either Nestle or Milkfed. Farmers linked with Nestle had two-and-a-half times more animals (21.4) than those associated with Milkfed (8.8). Normalizing the costs on a per-animal basis reveals that the gross (and net) profit of sampled dairy units integrated with Nestle were significantly higher than those integrated with Milkfed (see Table 2.14). While variable and fixed costs were higher with Nestle, due to higher quality livestock, feeding, housing, and sanitation conditions, the higher productivity linked with the dairy animals linked with Nestle more than compensated for these higher costs. This is reflected by the fact that the variable cost of producing one liter of milk was much lower (by about 32 percent) in Nestle-linked units due to the higher milk productivity of milch animals. Correspondingly, the total returns over total costs for Nestle-linked farmers were higher (1.33) than for farmers associated with Milkfed (1.13).

Table 2.14: Economics of Milk Production under Two Vertically Integrated Market Systems

Item	Per milch animal		Per liter of milk	
	Milkfed linked	Nestle linked	Milkfed linked	Nestle linked
Gross income (Rs)	23,725	31,850	11.55	10.15
Variable costs (Rs)	19,662	20,680	9.55	6.53
Feed (Rs)	9,473	9,987	4.60	3.15
Dry fodder (Rs)	1,555	1,733	0.76	0.55
Green fodder (Rs)	6,943	5,809	3.37	1.83
Veterinary care (Rs)	450	449	0.22	0.14
Labor (Rs)	736	2,243	0.36	0.71
Power charges (Rs)	359	387	0.17	0.12
Minor repairs (Rs)	145	73	0.07	0.02
Total returns over variable cost (Rs)	4,063	11,170	2.00	3.62
Fixed cost (Rs)	1,468	3,481	0.71	1.10
Net returns (Rs)	2,595	7,690	1.26	2.43
Total returns over variable cost	1.21	1.54	1.21	1.55
Total returns over total cost	1.12	1.32	1.13	1.33

Source: Primary survey conducted in 2005.

Higher milk productivity per animal, lower proportion of unproductive animals, better stock of milch animals, better nutrition provided to animals, higher proportion of cross bred cows, and better herd management practices contribute to the better economic performance of milk producers integrated with Nestle. The milk productivity per milch animal in Nestle integrated dairy units is 77.5 percent higher than for Milkfed dairy producers (see Table 2.15). Better livestock maintenance in Nestle integrated dairy units is reflected through higher fixed costs and expenditures on feed and labor per unit of milch animal.

Table 2.15: Determinants of Economic Efficiency of Milk Production in Punjab

Parameter	Milkfed integrated production system	Nestle integrated production system
Milk yield (kg)		
Cow	2,129	3,779
Buffalo	1,990	1,784
Milk price received per kg (6.5 percent fat) (Rs)		
Cow	9.63	9.81
Buffalo	13.60	13.52
Stock of milch animals (percent)		
Cross-bred cows	50	83.8
Buffalo	50	16.2

Source: Primary survey conducted in 2005.

Prices for buffalo milk are higher than for cow milk, but productivity of dairy cows is higher, which contributes in part to the higher net returns from dairy production by Nestle than through Milkfed.

2.6.2 Nestle India Ltd.: A Success Story in Dairy Development

Nestle India Ltd. started its operations in the city of Moga in 1961. The main aim of the company was to promote milk production in the state by linking milk producers with the processing facility. The basic premise of the company was to expand operations and encourage dairy production by gaining the confidence of its farmers. Nestle organized an economical milk collection system that could reach thousands of farmers, established an efficient and transparent analysis of milk composition to determine prices, ensured timely and fair payments to milk suppliers, and provided technical inputs and advice to farmers in order to increase milk production and reduce the costs of production. It adopted various strategies to promote dairy in the state (Dhaliwal 2003). These strategies have allowed Nestle India Ltd. to command a 75 percent share of milk sold in its milkshed area.

2.6.2.1 Milk Collection and Payment System

As a first step, milk collection centers that were designed to ensure direct contact with producers were established at the village level. As the linkages between Nestle and its farmers strengthened and grew, the number of milk collection centers, milk suppliers,

and milk procurement also increased. Milk procurement increased from 54.54 million kg in 1980 to 238 million kg at the end of 2002, an increase of 336 percent, due to an increase in the number of suppliers and the supply of milk per farmer, the latter resulting from an increase in the productivity of the animals (see Table 2.16). This success was achieved due to various schemes and strategies adopted by the company in the form of assured procurement of milk, high prices, and the provision of material inputs and technical advice. The nominal price of milk during the 1980s and 1990s more than doubled, encouraging farmers to adopt modern, commercial, and more efficient production practices.

Table 2.16: Growth in the Number of Milk Suppliers and Quantity of Milk Procured by Nestle India Ltd

Year	Number of suppliers	Milk supply per farmer (kg)	Yearly milk procurement (million kg)	Milk collection centers (No.)	Average milk price in Rs per kg of 6.5 percent fat	Veterinary medicines ('000 Rs)	Cattle feed (tons)
1961	180	4.6	0.051	4	-	0	0
1970	7,934	6.4	11.89	NA	-	56	725
1980	32,426	5.6	54.54	386	2.05	756	3,881
1990	57,948	9.1	136.01	518	4.65	2,590	9,927
2002	85,413	10.7	237.78	1,100	11.96*	11,034	20,654

Note: *refers to the year 2003; NA: Not available.
Source: Dhaliwal (2003).

2.6.2.2 Supply of Inputs and Services

Poor feeding practices, low quality animal feeds, and poor health of milch animals were identified as important factors contributing to low milk productivity. Nestle started various programs to improve feeding and health practices for the animals of its milk suppliers. It primarily focused on providing veterinary services, veterinary medicines, and nutritionally good quality feed to its milk producers. The nominal value of medicines and feed supplied to milk producers has increased significantly over time. These medicines are supplied at 'cost-to-cost' basis, in which Nestle enters into contracts with pharmaceutical companies and high-quality medicines are supplied to the producers without profit. Bulk buying further reduces the cost by about 20–25

percent. Animal feed is procured from reputed firms and prepared under the direct supervision of Nestle and is supplied at 'no profit, no loss' basis directly to farmers. Nestle India distributes about 50 percent of the feed requirements of milk producers who contract with them. Farmers are also guided to produce good quality fodder and silage throughout the year. Nestle further provides technical support to its dairy farmers by contracting 25 veterinary officers who work in the field on behalf of Nestle. Special campaigns against the outbreak of diseases are undertaken.

2.6.2.3 Improvements in Animal Productivity

Nestle India emphasizes breeding improvements of milch animals to raise their productivity. The company focuses on cross-bred cows due to their higher milk yield potential. Nestle introduced special incentives through better prices for cow milk that are based not only on fat content but also takes SNF (solids not fat) content into account. Consequently, the share of cow milk as a proportion of the total milk intake now stands at 44 percent in 2002 against zero percent in 1980. In order to improve the quality of livestock, Nestle provides quality bulls at a 75 percent subsidy or sometimes free of cost. Furthermore, Nestle runs 51 Artificial Insemination Centers and arranges for good quality semen from reliable and established sources. Farmers are only required to pay the labor costs of the inseminator.

Extension activities have been organized to impart knowledge and training to dairy producers in scientific farm management techniques, improvements in the health and pedigree of livestock, production and delivery of hygienic milk, and techniques that improve the productivity of milking animals. The extension programs include the organization of field days, group visits of milk producers to the company, talks at various interactive village camps, and distribution of literature on improving dairy practices. Recently, the company introduced a 'herd management' program, where dairy farmers are trained in a number of management, feeding, and housing techniques for animals aimed at improving their productivity.

The company further supplies milking machines to farmers at a 25 percent subsidy; 116 machines were distributed by the end of 2002. In addition, farmers with large herds have been provided with fodder harvesters.

2.6.2.4 Improvements in the Quality of Milk

In order to upgrade the quality standards of its farmers, Nestle has installed farm coolers at the village level and trains farmers to follow sanitary and hygienic measures at their dairy farms. As a result of these efforts, the quality of milk procured by the company continues to improve. As of 2002, about 40 percent of procured milk carried a bacterial load of less than half million total plate count (TPC) per liter. However, while the bacterial load has been significantly reduced, it remains far above EU standards, which is less than 0.1 million TPC per liter.

2.6.3 Factors Impeding the Growth of Dairy

A number of constraints currently impede rapid growth in the sector. The most important adverse factor is the nature and composition of livestock. For instance, the proportion of buffalo, who normally have lower milk yields than other milch animals, as a share of the total number of milking animals is very high (78.6 percent in 2003) and has increased since 1997 (when it was 74.8 percent). While cross-bred cows are more productive, their percentage of total milking animals has fallen slightly. While it is encouraging to note that the number and proportion of local cows in the total number of milch animals is on the decline, it must also be noted that the importance of buffalo has not diminished. An additional constraint related to the characteristics of the dairy herd is that it includes a large proportion of unproductive animals. According to the 2003 livestock census, 27.7 percent of adult female cattle were either dry or have not calved. While there has been considerable improvement in this percentage (for example, in 1997, the percentage of dry/not-calved animals was over 34 percent), it nonetheless hampers growth in the sector.

Productivity in the sector is further affected by availability of green fodder for animals, due to a significant rise in the number of cattle and stagnant growth in area under green fodder crops. The total number of animals over one year of age in the state increased by over 21 percent from 5.274 million in 1990 to 6.395 million in 2003. During the same period, the area under fodder in *kharif* and *rabi* seasons combined increased by just 12 percent from 802,000 ha to about 900,000 ha. Consequently, the number of animals fed per ha of green fodder has increased from 6.58 animals in 1990 to 7.11 animals in 2003. The present availability of green fodder of 17 kg per animal is grossly inadequate compared with the requirement of 40 kg per animal and results in poor health and low milk yields for dairy animals. Similarly, the quality of feed fed to animals is poor and not standardized according to the

requirements of the animal. Farmers mostly purchase feed on credit from the local commission agents (*arhtyas*) and the quality of the feed is generally sub-standard. In addition, animal feeding practices are such that the animals are fed with uniform ingredients that do not take into account the differing requirements of different animals to promote milk yields and good nutrition.

The net result of these constraints is persistently low milk yields of animals. While the average wet-yield of milk per lactation of 305 days in a year was estimated at 3,215 kg in 2003, substantially higher than the 1,491 kg per lactating animal reported in 1990, it is much lower than the potential reported by experts at the Department of Animal Sciences in Punjab Agricultural University. For example, the Murrah breed of buffalo has the potential to yield up to 4,000 liters of milk per lactation, while the Holstein Friesian cross-bred cow can yield up to 7,000 liters. This suggests that the realized milk yields in Punjab are only half that of the top breeds.

As with horticulture products, the dairy sector in Punjab is characterized by high variability in milk production from season to season, resulting in variability in milk prices and incomes of milk producers and the processing industry. The variability of milk yields is compounded by the predominance of buffaloes in the dairy herd, due to strong consumer preferences for milk containing a higher fat content. During the lean period (summer months), milk supplies to processors are severely constrained and capacity utilization is low. Small processing units without backward linkages incur losses during this period and often must temporarily idle their operations, which affects their economic viability. Such variability in milk production induces variability in prices, detrimental to milk producers and processors, particularly small-scale groups. During the flush season, low prices make dairy farming uneconomical for small farmers, while during the lean season, prices rise and make dairy processing economically unviable for small processors.

Recent reforms initiated by the government have had a positive impact on the development of the milk sector in Punjab. Previously, the Government of Punjab followed a policy of having a notified milkshed area for each processing plant, beyond which processors were not permitted to procure milk. This restriction on milkshed areas has been removed and processing units are now free to collect milk from anywhere in the state. This policy has helped to generate efficient and vertically integrated processing units that ensure increased quantity and better quality of milk throughout the year. Increased competition has also helped to raise milk prices for milk producers. The purchase tax on milk, which was 4 percent in 2002, has been reduced to 2 percent. In order to promote milk processing and production in the state,

the processing industry has requested an exemption from such taxes, similar to the concessions provided to the rest of the food processing industry.

2.7 Expanding Retail Food Market

The Indian retail market is in for big investments and the retail food market is on the verge of a rapid and marked transition. The recent notable joint ventures in high value commodities are Wal-Mart of US, Woolworth of Australia and Carrefour of France tying up with Indian industrialists such as Bharti (FieldFresh), Tata Group, Wadias respectively. Although Tesco of UK tying up with Tata has been unfounded, Tesco is trying to tie up with some retail giant to enter the market. Reliance and Birlas have decided to join the fray on their own, without going into any combined efforts with the foreign retailers. Reliance Industries, through its farm-to-fork network, is investing heavily in retail and farming. The Aditya Birla Group has acquired 90 percent stake in the southern retail chain Trinethra Super Retail. The Indian Tobacco Company Ltd. (ITC)—through their e-Choupal initiative, the single largest information technology based intervention in rural India—has empowered nearly 3.5 million farmers, spanning 36,000 villages in nine states. There are reports of its having signed Memorandums of Understanding (MoUs) with gram panchayats and farm producers' association to form rural hubs to connect the rural producers with the markets.

FieldFresh, the agri retail arm of Bharti, has forayed into Punjab in a big way. It has acquired 300 acres of farmland at the rate of approximately Rs 5,000 per acre from the Punjab government in Ladhowal, Ludhiana to set up the Agri Centre for Excellence (ACE), envisaged as a hub of R&D, information and knowledge dissemination, and crop and varietals trials. The farm includes 42 acres of state-of-the-art protected cultivation, including polyhouses, glass and green houses, and net houses. The farm is mainly into vegetables—growing sugarsnaps, snow peas, french beans, baby corns, carrots, okra, etc.—which have export markets in the US, Europe, and Middle East. FieldFresh has leased in 4,500–5,000 acres of lands from farmers across 78 farms.[11] FieldFresh at present operates in three districts, viz. Fatehgarh, Sangrur, and Jalandhar, and provides technology and expertise through Sutlej Power, which is primarily responsible for helping the farmers with the cultivation of crops. FieldFresh's mode of operation has been to initially acquire land from farmers on lease and undertake complete responsibility in investing in technology and cultivation and essentially own all the risks associated with it. This has enabled farmers with

[11] money.cnn.com, accessed on January 4, 2007.

small pieces of land to earn rents and also work on the land for a decent wage.[12] FieldFresh's role is more of a catalyst, helping the farmers turn around and explore the alternatives to rice–wheat cropping.

Reliance Retail—which recently unveiled its first retail format, Reliance Fresh—has plans to scale up to Reliance Fresh Plus. It is a venture to control the entire supply chain mechanism starting from the farmer to the distant vendor. Through its multi-stage intervention, it proposes to compress the supply chain and ensure more remunerative prices for the producers and lower prices for the consumers. It plans to invest $5 billion by 2011 and generate $20 billion in agricultural exports per annum.[13] Reliance is reported to have already signed a memorandum of understanding with the Punjab government in early 2006 to acquire land to set up rural hubs, to be supplied by hundreds of smaller villages, to buy vegetables, fruits, pulses, and dairy products from farmers. It is said to be pursuing similar deals in West Bengal, Haryana, Uttar Pradesh, and Uttaranchal. In order to have a captive cargo operation, it is planning to induct 40 35-ton cargo planes to transport these goods.

As it appears today, three things will follow: (i) the food chain in India will be radically changed, operating on a nationwide distribution infrastructure and transforming the way the nation shops and consumes, (ii) the huge amount of retail investment by major businesses will practically guarantee success if supplies can be obtained, and (iii) there will be a rush to tie up producers to provide the supplies. If Punjab can get its act together, smallholders could be large beneficiaries.

This vision of the future is not so fanciful. The Indian retail food market is antiquated. India has a population of over a billion people, the economy is growing at 8 percent per year for the last three years, and the middle class is expanding rapidly. The United States and Europe, Latin America, and South-east Asia have pioneered the new retail pattern, with Latin America doing so at an even faster pace than the US.

Thus, it is not a question of whether the retail boom will happen or not but when—in one year, in five years, or in 15 years. Those that participate earliest in this retail boom will gain the most. It remains to be seen whether Punjab will be at the head of the line or among the laggards.

[12] Land is leased in at the rate of Rs 10,000–20,000 per acre and laborers are offered a daily wage of Rs 120 (field visit).
[13] *The Economic Times*, July 10, 2006.

2.8 Government Programs to Support High-value Agriculture

The Punjab government has initiated several ventures to promote high-value agriculture in the state. These are described below.

2.8.1 Punjab Agro Industries Corporation Limited

The Punjab Agro Industries Corporation Limited (PAIC) has established a number of projects to assist in the distant marketing of fruits, vegetables, and flower products. Programs are available to registered growers and exporters to reimburse charges on packaging and freight (see Appendix Table A2.4). PAIC has established a number of waxing and cold storage plants aimed at adding value to fruit production. Soft loans[14] are available to entrepreneurs to invest in post-harvest and cold chain infrastructure.

In a relatively new initiative, PAIC is partnering with PepsiCo's Tropicana division to establish a juice production plant for sweet oranges.[15] In the first part of the project, PAIC will invest Rs 50 million to establish state-of-the-art facilities for raising imported citrus saplings (from Florida) which will be provided to farmers at a cost of Rs 50 per tree (approximately 117 trees can be planted on one acre, or 289 trees per ha). The citrus propagation facility established by PepsiCo has the capacity to process a potential transplantable area of over 14,000 ha per year.

Land will be leased from farmers during the first five years of the project (which was initiated in 2006) at half the going lease rate (presently Rs 15,000 per year), after which there will be 50–50 output sharing between farmers and PepsiCo (years 6–15). After 15 years, the orchards will belong to the farmer. Special training and demonstration sessions will be conducted for farmers to acquaint them with appropriate cultivation practices. Farmers will have the option to sell part or all of the production to PepsiCo. It is hoped that farmers and additional juice processing investors will be enticed by such a program, since orange production can yield income three times higher than the present alternatives.[16] The Punjab government has

[14] The terms are as follows: interest rate of 10 percent, with a two-year interest holiday and repayment to be made every other month over a 10-year period. Fifty percent of the asset value is required as collateral.

[15] Reportedly, Tropicana feels that the citrus varieties currently grown in the country are not appropriate for juicing; kinnow cannot produce an internationally acceptable product because it has low percentage of limonene in the juice. See ANZDEC (2005).

[16] Citrus is less water-intensive than paddy. Farmers are encouraged to use drip irrigation, which reduces the water requirements by half. However, initial investment is high (Rs 12,000 per acre for drip irrigation cables) and cables must be replaced every 5–6 years.

established a goal of bringing one million acres (404,694 ha) under citrus cultivation by 2015.

PAIC is also involved in three other projects to assist diversification efforts. First, it has implemented a grape improvement project in order to develop processing, wine making, and new table varieties of grapes. The organization has signed a memorandum of understanding with Sula Wines to collaborate on activities to identify suitable domestic and imported varieties for cultivation in the state. Demonstration stations are to be established, with trials to begin during the spring of 2006. Second, it is promoting organic farming and has worked to provide certification services for its farmers. At present, 1,126 farmers on 7,200 acres (2,915 ha) have been registered as organic farmers. PAIC pays organic farmers premiums above the higher of the MSP or the prevailing market price (5 percent more for the first year crop, 10 percent for the second year crop, and 15 percent more in the third year onwards). The government has set a total target of 100,000 acres (40,485 ha) of organic farming producing a variety of different crops (wheat, basmati, paddy, sugar cane, and horticulture products). The PAIC is working to establish a perishable cargo center at Amritsar to facilitate the export of horticulture and floriculture commodities. In December 2006, the Prime Minister announced Rs 800 million for upgradation of Amritsar airport and setting up a perishable cargo facility for horticulture export (*The Tribune* 2006).

2.8.2 Council for Citrus and Agri Juices

Several councils have been set up under the state initiative to diversify from the rice–wheat cycle into high value horticulture, citrus and viticulture. The Council for Citrus and Agri Juices has been set up to attract farmers into citrus farming through assured returns including cash support and sharing of profits. It offers two types of models of contract farming. Under the first model, for the first six years the Council will pay sustenance based on soil quality with guaranteed enhancement at the rate of 2 percent, while in the remaining six years net profit from the sale of fruits will be shared equally. In the second model, the Council will pay sustenance based on soil quality with guaranteed enhancement of the rent at the rate of 20 percent after every three years. The developed orchard will be handed over to the farmer after 12 years. The Council is also setting up two plants for processing citrus juice to assure markets for the farmers and also encourage them to grow processing varieties of citrus (Singh 2006).

2.8.3 Punjab State Agricultural Marketing (Mandi) *Board*

The Punjab State Agricultural Marketing (*Mandi*) Board was set up under the Punjab Agricultural Produce Markets Act, 1961 to regulate the marketing, sales, purchase, storage, and processing of agricultural produce. A total of 145 Agricultural Produce Marketing Committees (APMCs) have since been established under the Act. Each marketing committee has a principal marketing yard, one or more sub-market yards, and seasonal purchase center.

Direct marketing yards for small producers known as *apni mandis* enable farmers to receive higher returns from direct sales, while obtaining the benefits of selling in a regulated market. In an *apni mandi*, a daily price list is displayed by the *Mandi* Board, which mandates the sales price for all products in the *apni mandi*, thus providing a source of price transparency for buyers. The *Mandi* Board also provides basic infrastructure facilities at its designated venues. Currently *apni mandis* operate in 22 major cities in the state and roughly 27,000 farmers participate each month.

Refund of market fees is given for the purchase of fruits and vegetable exports to other countries.

2.8.4 Punjab State Farmers' Commission

The Punjab State Farmers' Commission (PSFC) was established in July 2005 to address farmer concerns such as formulating strategies for agricultural diversification, given the changing external environment [especially in the context of the World Trade Organization (WTO)], strengthening infrastructure support to the agricultural sector, and assessing the potential of agriculture and allied sectors in generating rural employment. The PSFC undertakes applied research in conjunction with state agricultural universities and research organizations. Such studies include research on the utilization and requirements of agricultural credit, agricultural indebtedness, and the certification of Punjabi potatoes as free of brown rot to facilitate exports to Germany.

The PSFC has been actively trying to promote policy incentives for agricultural diversification. It is attempting to pass legislation that would ban paddy nursery transplantation before the end of May 2007 in order to save water resources that are wasted from early transplantation.[17] The PSFC has also introduced low poly-tunnel

[17] It is also working on developing mechanization to replace the work of migrants from Bihar in transplanting rice, whose availability in May and early June is a prime reason for the early sowing and depletion of the water table.

vegetable cultivation, which promises to yield 50 percent more returns as compared to the conventional practices. The Commission negotiates with banks to bring down interest rates on credit provided to farmers to 7.5–8 percent

In a report 'Agricultural and Rural Development of Punjab: Transforming from Crisis to Growth', issued in May 2006, the Commission analyzed the historic growth of agriculture and provided a blueprint to transform Punjab agriculture. It proposes a comprehensive strategy to address the challenge emphasizing improving infrastructure, increasing capital formation, restructuring incentives, and streamlining institutions to boost public and private investment in the agricultural sector (Government of Punjab 2006c). One interesting proposal made by it is production of maize for ethanol.

2.8.5 Markfed

The Punjab State Cooperative Supply and Marketing Federation Ltd. (Markfed) was established in 1954 and has emerged as a major cooperative with nearly 1.2 million member farmers. Most activities center on grain procurement and processing, although processing of fruits and vegetables takes place under Markfed's brand name 'Sohna', including jams, ketchups, and honey that are mainly directed for use by the military.

Markfed has been designated as the nodal agency for setting up Agricultural Export Zones to facilitate exports of agricultural commodities, such as potatoes, wheat, and rice, plus ready-to-eat products from Punjab. Markfed will facilitate the process and provide technical support. Markfed plans to invest in cold storage facilities at Dhandari Kalan (Ludhiana) to help ensure the quality of produce, with Agricultural and Processed Food Products Export Development Authority (India) (APEDA) promising to fund 25 percent of the investment cost, pending a feasibility review. APEDA anticipates that exports to EU countries will start in 2007, while around 10,000 tons of potatoes will be exported to Malaysia, Singapore, Dubai, Sri Lanka, and the Maldives in 2006.

2.8.6 Other State Initiatives

The Punjab government has recognized the importance of the need for crop diversification in its 2005–06 Annual Plan as published by the State Planning Commission. A total of Rs 3.2 billion was allocated for 2005–06 in order to meet the state's goal to shift one million ha of wheat and paddy cropland into alternative

products. It is envisioned that in the initial stage, 250,000 ha will be diversified. The main mechanism proposed in this scheme is to provide payments of Rs 12,500 per ha to those farmers who adopt alternative commodities (Government of Punjab 2006a).

The National Horticulture Mission Action Plan for 2005–06 identified specific production clusters and investment plans to promote fruits and vegetables in specific agro-climatic zones of the states. The program is funded fully through the Government of India (GOI) during the Tenth Five-year Plan, with GOI assistance falling to 85 percent in the 11th Five-year Plan (the balance to be contributed by the state). The plan argues that marketing is the primary constraint for the development of horticulture products and seeks to: promote products that are demand-driven; facilitate the development of marketing chains through amendment to the APMC; create necessary infrastructure for post-harvest management, grading, storage, and transportation; and work with APEDA to develop export markets. The plan further envisions providing technical support and materials to farmers and the promotion of contract and organic farming.

2.9 Policy Implications

Diversification into high-value commodities has the potential to revitalize agriculture and increase farm income in Punjab. Many high-value alternatives could generate more net revenue per ha than wheat or paddy—for some products, notably citrus (in particular, kinnow), onions, and dairy, the per ha returns are significantly higher. As long as the farmers have coverage for both price and production shocks, they are willing to turn around and experiment with high value commodities. High-value products tend to be more labor-intensive than wheat or paddy, which contributes to increased employment but may present problems for households that are labor-constrained. High-value commodities generally require less water than either paddy or wheat.

The rise in MSPs of wheat and rice *vis-à-vis* alternative crops has created price disincentives for diversification. In particular, the growth in prices during the 1990s, fueled by strong rises in the MSP, was higher for wheat and rice than every other commodity except kinnows. Moreover, such policies magnify the inter-year seasonality of HVCs by artificially stabilizing grain prices, which are further exacerbated by the lack of risk mitigation strategies such as crop insurance and storage infrastructure. On the other hand, slow growth in MSPs for wheat and rice in the early 2000s (in an effort to bring down public stocks) coupled with strong price growth in

horticulture has presented an opportunity for greater diversification into alternatives. Grain management will be analyzed in more detail in the next chapter.

The marketing infrastructure established by the government has facilitated the movement of rice and wheat from Punjab to other areas of the country. However, marketing policies, particularly the Agricultural Produce Marketing Committee (APMC) Act, hinder the development of vertical linkages between producers and buyers (processors, etc.), which prevents the scaling up of agribusiness activities in the state. The APMC mandates that most agricultural products, including horticulture products, must be marketed through regulated markets (*mandis*). While Punjab is blessed with a dense *mandi* system such that purchase centers are within 10 km distance from most villages, the system has not adapted to the changing demands of horticulture buyers (World Bank 2003c). Just one out of ten *mandi* yards had a cooling tower, while just two out of ten had a grading machine, items that are essential for the distribution of high-quality horticultural produce (World Bank 2005). The ability of traders to stock commodities to take advantage of seasonal price changes is inhibited by the Essential Commodities Act (ECA).

Technological developments have played a significant role in ushering high growth in the rice and wheat based crop sector in Punjab since the 1960s at the expense of alternative crops such as horticulture commodities (Sidhu and Singh 2004). The share of wheat and rice crops in total public research expenditures has increased over time, from 16 percent in 1980 to 20 percent in 2001. On the other hand, budgetary expenditures on horticulture have stagnated at 12 percent.

Recognizing some of the problems inherent with contract farming, the Punjab government has been working to support contract farming by underwriting some of its risks. In particular, it has offered farmers a ‘comfort price’ that guarantees the farmers a minimum price for their product. This program remains in its infancy, but the inadequacy of the written contract coupled with fewer guarantees to buyers in the case of side-selling by farmers suggests potential problems with this model in the future, with such difficulties potentially becoming the burden of the state. Such contractual problems remain stymied by the lack of implementation of stricter contractual obligations as mandated by the model APMC Act. More troubling is the increasing role of government in fixing prices for high-value commodities through contract farming or its initiative to promote organic farming by mandating government-backed price premiums. While a successful high-value commodity sector requires price incentives that encourage farmer participation, these should ideally be driven by market forces and not be underwritten by the state, particularly since such subsidies

would lead to high levels of economic inefficiency. Also, it is essential to build a relationship of trust and confidence among the farmers and the processors. Often the farmers are apprehensive about the credibility of the industrialists and shy away from contractual agreements.

Furthermore, while public policy can play a key role in developing farm-retail linkages, it should be careful not to be overly biased towards specific types of linkages. In particular, the incentives provided to contract farming over other types of coordination need to be examined, since successful cases of contract farming tend to be those that are quite specific both to the type of product and level of competition within a given sector. Indeed, it is quite possible that for some HVCs, more coordinated spot sales through modern sales yards or horizontal coordination via producers associations may be more appropriate and sustainable in the long term. The case of Nestle demonstrates that informal contracts—in which Nestle provides key services and timely, market-based payments to farmers—may be a better vehicle to limit the problems with contracts in an environment characterized by high transactions costs in formal contract enforcement and applicability (Klein 1996). The catalytic approach of FieldFresh in acquiring land and undertaking all production and price risks might assure farmers of credible high value farming opportunities and make a turnaround. The ITC e-choupal is unique in its approach of farmer empowerment, providing different types of information and technology through extension services. Such a model provides a means to incorporate smallholders into high-value markets. Which type of arrangement might be best for each particular commodity still remains unclear.

Appendix Table A2.1: Value of Imports of Fruits and Vegetables by Selected Countries in Selected Years

(in million US$)

Country	Year							% growth (1999–2003)
	1990	1995	1999	2000	2001	2002	2003	
EU-15 (Excluding intra-trade)	13,452	15,156	14,320	12,841	12,977	14,077	17,339	21
Australia	313	398	514	470	454	512	615	20
Bahrain	64	72	34	107	132	149	118	245
Canada	2,479	2,762	3,220	3,334	3,397	3,739	4,065	26
China	397	659	945	1,063	1,240	1,208	1,420	50
Japan	3,713	6,294	6,209	6,230	5,901	5,586	5,837	-6
Kuwait	150	256	276	294	285	136	137	-51
Oman	107	102	105	96	121	141	155	48
Qatar	55	62	55	78	89	92	90	64
Saudi Arabia	553	644	658	690	705	750	791	20
Singapore	616	872	639	611	593	612	602	-6
United Arab Emirates	468	637	581	536	513	869	931	60
United States of America	6,695	7,548	10,541	10,634	10,803	10,124	13,038	24
TOTAL	29,061	35,463	38,098	36,986	37,210	37,996	45,138	18

Source: FAOSTAT website http://faostat.fao.org/, accessed March 12, 2006.

Appendix Table A2.2: Comparison of Competitiveness of Indian Horticultural Products in Selected Markets, 2003–04

HTS code	Product	f.o.b export unit value (US$ per kg)	Freight cost (Rs 80 per kg)	Landed price (US$ per kg)	c.i.f. import unit value (US$ per kg)							
					Bahrain	France	Germany	Oman	Saudi Arabia	Singapore	United Kingdom	United States
Case I: Freight rates to overseas markets at Rs 80 per kg												
070110	Seed potatoes	0.16	1.78	1.93	1.32	0.46	0.40	0.64	0.55	NA	0.68	0.22
070190	Other potatoes	0.10	1.78	1.87	0.28	0.28	0.30	0.25	0.13	0.32	0.46	0.26
0702	Tomatoes	0.15	1.78	1.93	0.23	0.86	1.26	0.32	0.22	0.57	1.52	1.20
0703	Onions	0.17	1.78	1.95	0.22	0.68	0.53	0.24	0.18	0.34	0.54	0.73
070810	Peas	0.57	1.78	2.35	0.59	2.05	2.06	0.24	0.38	1.22	3.20	1.04
080510	Oranges	0.21	1.78	1.99	0.40	0.73	0.60	0.41	0.28	0.75	0.59	1.07
Case II: Subsidized freight to overseas markets at Rs 50 per kg												
070110	Seed potatoes	0.16	1.11	1.27	1.32	0.46	0.40	0.64	0.55	NA	0.68	0.22
070190	Other potatoes	0.10	1.11	1.21	0.28	0.28	0.30	0.25	0.13	0.32	0.46	0.26
0702	Tomatoes	0.15	1.11	1.26	0.23	0.86	1.26	0.32	0.22	0.57	1.52	1.20
0703	Onions	0.17	1.11	1.28	0.22	0.68	0.53	0.24	0.18	0.34	0.54	0.73
070810	Peas	0.57	1.11	1.68	0.59	2.05	2.06	0.24	0.38	1.22	3.20	1.04
080510	Oranges	0.21	1.11	1.32	0.40	0.73	0.60	0.41	0.28	0.75	0.59	1.07

Note: For HTS 070110 (i) unit value for Bahrain is for 2004 only, and (ii) figures for Saudi Arabia are for 2003 only.
Source: UN Comtrade.

Appendix Table A2.3: Major Processing Projects Undertaken with PAIC

Company	Capital (Rs million)	Capacity (million tons)	Raw material(s)	End product(s)
Pepsi Food Ltd.	685	• 800 million tons per annum snack food • 20,000 units beverage concentrate • 12,000 million tons per annum processed fruits and vegetables	• Tomatoes • Potatoes • Chilies	• Snack foods • Soft drink concentrate • Processed fruits and vegetables
Nijjer Agro Foods Ltd	194.9	• 15 million tons per hour of tomatoes • 150,000 liters of milk per day	• Tomatoes • Milk • Chilies	• Tomato paste • Chili paste • Guava concentrate • Hybrid seed • Ghee • Milk powder • Condensed milk
Agro Dutch Industries Ltd.	235	• 28,000 million tons per annum (expanded from 3,500)	• Paddy • Straw • Mushroom • Spawn	• Canned mushrooms
Himalayan Frozen Foods Ltd.	97	• 5,400 million tons per annum of raw materials; freezing rate of 2 tons per hour	• Fruits and vegetables	• Frozen fruits and vegetables
Pagro Foods Ltd.	75	• 11,600 million tons per annum	• Fruits and vegetables	• Frozen fruits and vegetables • Processed fruits and vegetables

Source: Punjab Agro Industries Corporation Ltd. website http://www.punjabagro.com/pagrexco.htm, accessed February 27, 2006.

Appendix Table A2.4: Incentives Offered by the Punjab Agri Export Corporation Ltd. (PAGREXCO) for Horticulture Products Sold to Distant Markets

Type of assistance		
Fruit exports		
	Kinnows	*Grapes*
Packaging	15 percent (10 kg box)	25 percent (4 kg box)
Inland haulage (transportation)	15 percent	25 percent
Waxing at PAGREXCO grading centers	Re 0.75 per kg subsidy	
Pre-cooling-cum-cold storage at PAGREXCO	Re 1 per kg subsidy	Rs 1.50 per kg subsidy
Vegetable exports		
Packaging	25 percent (5 kg box)	
Inland haulage (reefer)	25 percent	
Air freight	25 percent (up to a maximum of Rs 25 per kg)	
Import of seed and planting materials	50 percent	
Subsidies on X-ray charges	25 percent	
Flower exports		
Packaging	25 percent	
Inland haulage (reefer)	25 percent	

Source: Punjab Agro Industries Corporation Ltd. website http://www.punjabagro.com/pagrexco.htm, accessed February 27, 2006.

Chapter 3
Foodgrains Management

Foodgrains understandably dominate agricultural policies in general and agricultural marketing in particular. Foodgrains have been the staple of the Indian diet, particularly of the poor. At times, the country has been short of foodgrains. Political fortunes have been made—and lost—on the basis of foodgrains availability and prices.

Public foodgrains management made a positive contribution during the early years of the Green Revolution. Since then, however, the scenario has changed. Costs have risen and benefits have declined.[1] The conditions that justified the earlier public intervention have changed: infrastructure has improved, spatial integration of markets is better, protection against price risks of new technologies is no longer necessary, foreign markets are less volatile, and India has a large foreign exchange reserve. Food security involves more than just foodgrains alone, and is more than just availability; access plays an equally important role. Guaranteed procurement of wheat and rice—in effect, a contract by the government with farmers—at high prices provides disincentives to farmers to diversify. Scarce resources are being diverted from more productive investments, particularly modern infrastructure, to support production and marketing of high-value commodities. And the dominant position of the public sector in marketing inhibits the development of the private sector, which is more efficient in purchasing, moving, storing, and selling agricultural commodities. It is thus time to rethink the role of the public sector foodgrains management and the role of private marketing.

This chapter describes the prevalent marketing systems for wheat and rice, the public sector foodgrains management operation, costs of the public system with comparison to private sector alternatives, rationales for the public system, and prospects for private sector marketing. The chapter concludes by summing up the implications for Punjab's agricultural development in general and for diversification in particular.

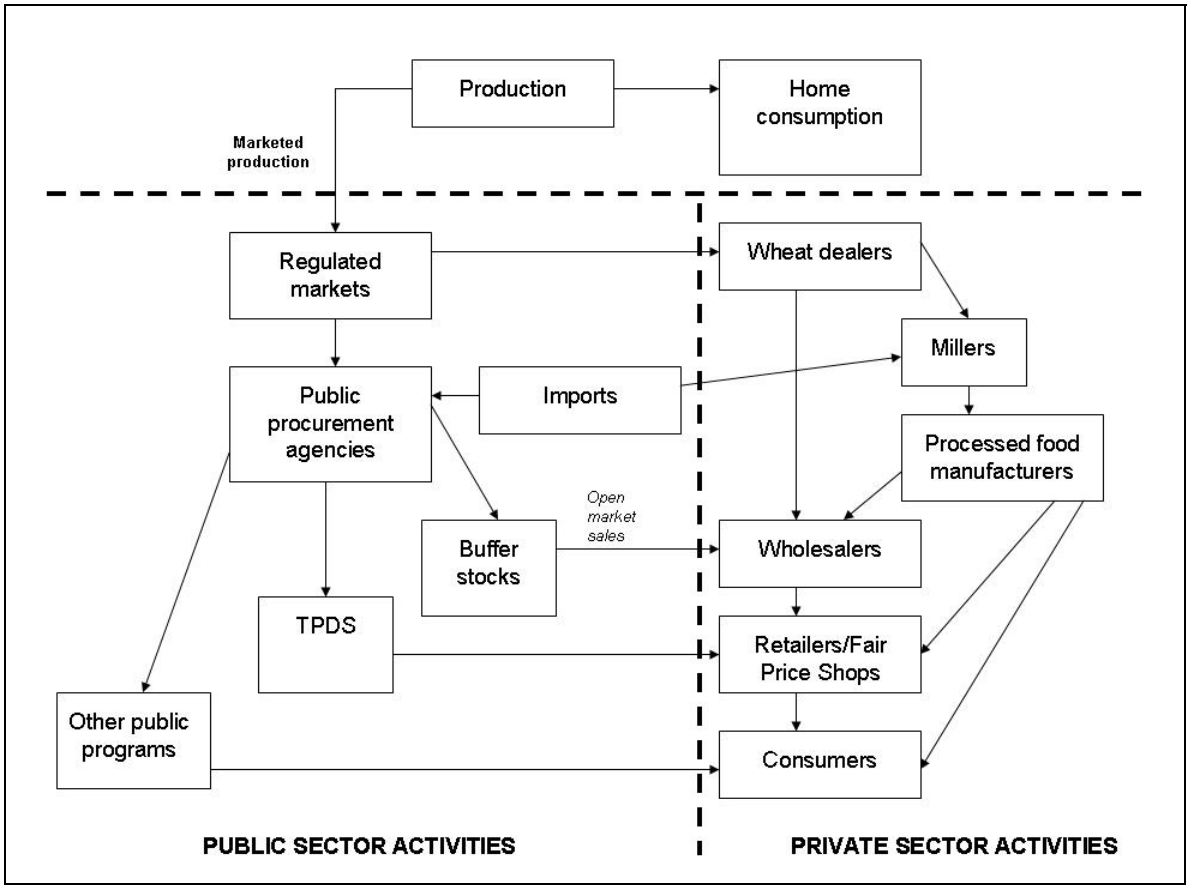
[1] Costs refer to the subsidies, poor scope for high-value agriculture (i.e. shift to diversification), leakages in the Public Distribution System, crowding out of private players, environmental degradation (in particular, the declining water table). The declining benefits refer to falling production and poor off-take from the public distribution network.

3.1 Overview

The distribution channel for wheat is shown in Figure 3.1. A significant proportion of production is consumed on-farm, with marketed production accounting for 55 percent production in 1999–2000) (GOI 2002e). Home consumption is milled informally. All marketed consumption is sold through regulated markets, *mandis*, with most (until 2006) being procured by the public sector and the remainder sold to private wheat traders. Public sector procurement provides support to public distribution programs such as the targeted public distribution system (TPDS), other specialized public programs, and buffer stocks held by FCI. Portions of the FCI-held buffer stocks are sold in the open market to wholesalers, depending on whether prevailing market prices are high and/or to dispose of surplus grain. TPDS grain is sold to retailers or fair price shops (FPS), which administer the sale of grain to consumers at subsidized rates. Imports are usually made by the public sector. The private sector purchases are sold to wholesalers, retailers, millers, and consumers.

The distribution channel for rice is similar to that of wheat but with two major exceptions. First, almost all of rice produced in Punjab is marketed. Secondly, Punjab is unique among Indian states in that a high proportion of procurement is in the form of paddy. Public procurement agencies contract with private millers to custom mill state-procured paddy for distribution or storage under state control. In addition, a variable proportion of rice purchased by millers must be sold to public procurement agencies in the form of a levy system.

Figure 3.1: Supply Chain for Wheat in India



Source: Adapted from World Bank (1999).

Box 3.1: Background to Foodgrains Management Policies

Food policy in India has its origins during World War II, in response to a sharp rise in foodgrains prices. The Bengal Famine of 1943 accelerated the scope of public intervention. Subsequently, the newly established Food Department was entrusted with the task of controlling all foodgrains activities, including buffer stock maintenance, procurement, import, price regulation, and storage (Chopra 1981).

Government intervention in the foodgrains market was haphazard after independence, with policy changes being typically reactive to the consequences of past policy actions. The Foodgrains Enquiry Committee in 1957 recommended the creation of a government organization that would conduct the activities of the previous Department of Food and act as a trader in the market, with the aim of stabilizing prices and supplies and curbing perceived speculative activities by traders. By 1965, these objectives plus the need to disseminate high-yielding varieties and ensure low-priced food to consumers led to the setting up of the Food Corporation of India (FCI) and the Agricultural Prices Commission. Droughts in 1965–66 and 1966–67 necessitated massive emergency food aid imports from the United States and subsequently expanded the scope of the FCI. These actions combined with the successful dissemination of Green Revolution varieties significantly improved food security in the country.

The foodgrains management system began to receive criticism in the 1980s (Radhakrishna and Subbarao 1997; Gulati 1989; Gulati et al. 1990). The macroeconomic crisis faced by India in the early 1990s and a series of influential policy studies provided the guise for the liberalization of agriculture. Private rice exports were allowed in 1994–95, resulting in exports of 1 million tons in 1994 and 5 million tons in 1995. This was soon followed by liberalization of wheat exports (Gulati and Mullen 2003).

In response to the increasing criticism, the government sharply raised the minimum support prices (MSP) to producers during the 1990s, over and beyond the levels recommended by the Commission for Agricultural Costs and Prices (CACP). The government further modified its public distribution system into a targeted public distribution system (TPDS), with motivations to better target subsidy payments to those who needed it most and to reduce the food subsidy bill. The combination of these policies led to a significant rise in procurement and fall in food distribution, resulting in a massive accumulation of foodgrains stocks. Stocks of rice and wheat increased to about 65 million tons in the summer of 2002, with food subsidies reaching Rs 175 billion in 2001/02. The buffer stock component of the food subsidy bill alone accounted for Rs 59 billion (GOI, *Economic Survey 2004*).

In October 2000, the government exported two million tons of wheat at a price 50 percent below the government's cost of acquisition. The volume of subsidized exports of rice and wheat rose further in 2001–02 and 2002–03. Objections by trading partners challenged the legality of such a policy under WTO obligations, and the policy was stopped in 2002. Leakages continued to rise during 2003–05, including greater off-takes from the public distribution system.

By early 2006, the net effect of the government's grain management policies was a significant reversal of the situation that existed just four years earlier. Buffer stocks, once at record high levels, were at record low levels. Market prices for wheat were well above MSPs and imports of wheat were authorized in February 2006 (USDA–FAS 2006).

The state of Punjab was one of the first states to intervene in foodgrains markets. The state Department of Food and Supplies was established in 1942, and monopoly procurement by it began in 1945. Since the late 1940s, the foodgrains management system of Punjab has been characterized by the creation of zones, imposition of movement restrictions at various levels, and licensing of dealers.

Significant movement restrictions, even at the district level, were put in place in 1957. Exports of rice/paddy were also banned. As a result of shortfalls in rice production, licensed dealers were required to sell 75 percent of the quantity of rice held as stocks to the government. Additional movement controls included banning of wheat exports from Punjab in 1964 and paddy exports (without a permit) in 1968. The movement controls of the 1960s and 1970s were gradually relaxed in the 1980s and 1990s. Such trends were accompanied by a decrease in the mandatory levy of rice to be sold to the government (from 90 percent to 75 percent).

FCI was joined by a number of state-level agencies in the procurement of wheat in the early 1970s and rice in the late 1970s, with increased total procurement leading to greater state agency participation. The Punjab State Civil Supplies Corporation Ltd. (PUNSUP) was established in 1974 to procure, store, and deliver wheat and paddy to the Central pool. The Punjab State Cooperative Supply and Marketing Federation (Markfed) also began to procure wheat for the Central pool in 1967, though its main mission concerned promoting cooperatives and distributing fertilizers. Similarly, the Punjab State Warehousing Corporation (PSWC) and PAIC began procuring foodgrains in the 1990s; procurement by the latter shifted to its subsidiary, the PAFC, in 2002. In March 2003, the Government of Punjab approved the creation of PUNGRAIN (Punjab State Grain Procurement Corporation) to procure foodgrains in place of the Department of Food and Supplies. This was motivated by the removal of food credit from the state budget and streamlining of the repayment of food credit to commercial banks.

3.2 Components of the Foodgrains Management System

The public sector has practically replaced the private sector in marketing wheat and rice in Punjab. The main activities are procurement, distribution, and maintenance of food stocks.

3.2.1 Procurement

The state government (through FCI and state-level organizations) procures wheat and paddy at the MSP established by the Central government. For wheat and paddy, the MSP constitutes the guaranteed price at which the government will purchase all the produce that is offered for sale provided the produce meets the prescribed specifications. [2]

3.2.1.1 The Link between MSP and Procurement

In principle, MSPs are established based on recommendations of the CACP that annually assesses the cost of production, changes in input prices, input/output price trends, market prices, inter-crop price parities, demand and supply situation, parity between prices paid and prices received by the farmers, etc. The CACP uses C_1, C_2, and C_3 cost concepts in its calculations, where C_1 cost refers to all paid up costs plus imputed value of family labor, C_2 cost refers to C_1 plus rental value of land, and C_3 cost provides remuneration to farmers at the C_2 cost plus 10 percent of C_2 cost to account for the managerial input of the farmer. In practice, MSPs were significantly higher than the CACP recommendations in the 1990s, although growth in MSPs has slowed during the past few years and recently has become more in line with recommended CACP prices (see Appendix Table A3.1). Since 2001, the MSP for wheat and paddy has increased by about Rs 10 per quintal each year. At the same time, farmers in Punjab have benefited from 'drought relief' bonuses that were awarded in recent years by the Central government, despite the fact that most farmers in the state have ample access to water (World Bank 2004). Moreover, while MSP is pan-territorial, C_2 costs (and A_2+FL costs, which measure total cash costs and the imputed costs of family labor) vary by state, implying that the subsidy provided to farmers can vary significantly.

Table 3.1, comparing MSP, C_2, and A_2 cost levels, and returns over costs for wheat and paddy in Punjab and all-India, demonstrates that farmers in Punjab receive a significant windfall from government support programs.

[2] The government, in practice, 'contracts' with farmers for wheat and rice production. The 'fair average quality' specifications prescribed for paddy in 1999 were 18 percent moisture content, 1 percent foreign matter, 3 percent damaged and discolored grain, 3 percent spotted/weevil-infested grain, 3 percent green and immature grain, and 10 percent other grains.

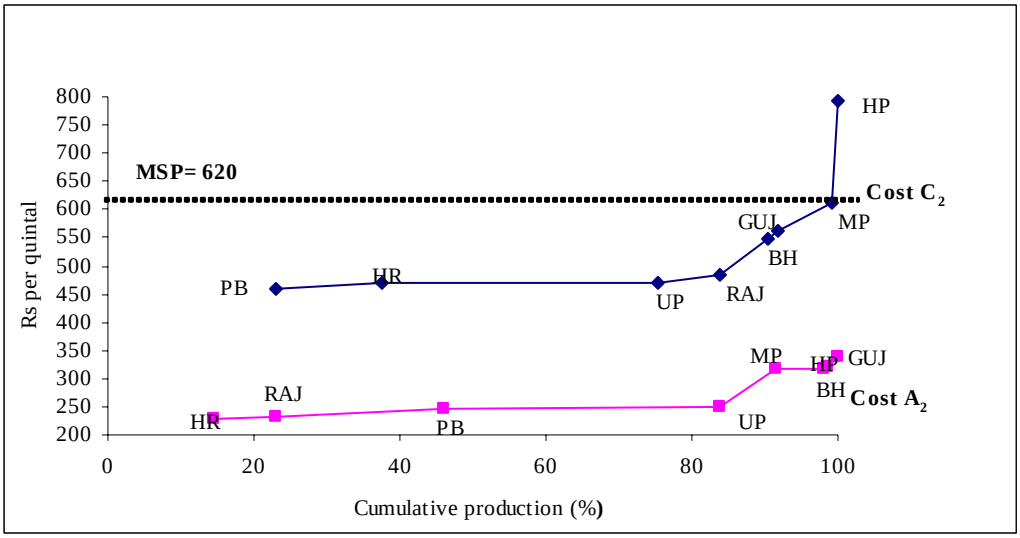
Table 3.1: MSP, C_2 and A_2+FL Costs, and Returns over Costs for Punjab and All-India, 2004–05

Item	Punjab		All-India	
	Paddy	Wheat	Paddy	Wheat
MSP (Rs per quintal)	560	640	560	640
C_2 costs (Rs per quintal)	442	487	531	516
A_2+FL costs (Rs per quintal)	287	294	384	343
Procurement (million tons)	10.044	9.258	17.427	16.8
Return at C_2 costs (Rs million)	11,852	14,165	5,054	20,832
Return at A_2+FL costs (Rs million)	27,420	32,033	30,672	49,896
Percentage of return at A_2+FL costs	195	217	145	187
Percentage of return at C_2 costs	127	131	105	124

Source: Government of India, *Reports of the Commission for Agricultural Costs and Prices*, various years.

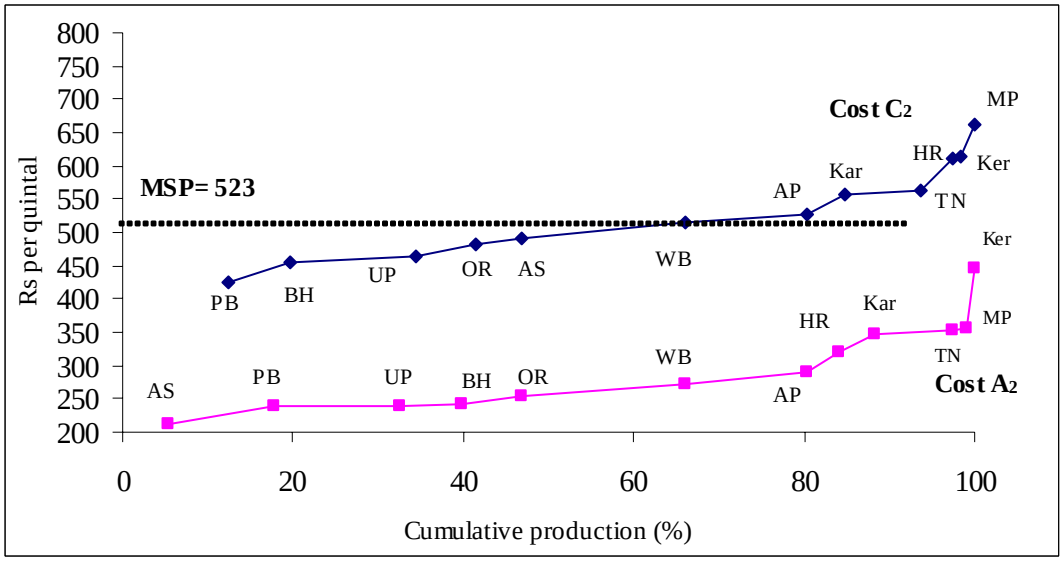
Indeed, because MSP is the same for all states and C_2 and A_2 costs (which is a more revealing measure of cost of production) are much lower in Punjab than in other states, combined with the high yields, Punjab farmers receive very high returns per ha and per holding on wheat and rice, higher than in other states (Figures 3.2 and 3.3).

Figure 3.2: Cumulative Production (%) and Costs (C_2 and A_2): Wheat (TE 2002–03)



Note: BH: Bihar; GUJ: Gujarat; HP: Himachal Pradesh; HR: Haryana; PB: Punjab; MP: Madhya Pradesh; RAJ: Rajasthan; UP: Uttar Pradesh.
Source: Appendix Table A3.2.

Figure 3.3: Cumulative Production (%) and Costs (C_2 and A_2): Paddy (TE 2002–03)



Note: AP: Andhra Pradesh; AS: Assam; BH: Bihar; GUJ: Gujarat; HP: Himachal Pradesh; HR: Haryana; Kar: Karnataka; Ker: Kerala; MP: Madhya Pradesh; OR: Orissa; PB: Punjab; RAJ: Rajasthan; TN: Tamil Nadu; WB: West Bengal; UP: Uttar Pradesh.
Source: Appendix Table A3.3.

Based on these calculations, the MSP is seen to cover the full costs of almost all the wheat production and two-thirds of rice production in the country—a very attractive prospect for India's wheat and rice farmers. Thus, when market prices are below MSP, the FCI pre-empts the market, farmers cover full costs (or more for the more efficient producing states), and PDS inventory and buffer stocks fill up; when market prices are above MSP, private traders enter and farmers make even higher income than what they would have earned if they had sold at MSP, but PDS inventories and buffer stocks are depleted.

Under the present system, the PDS and buffer stocks depend on the MSP level relative to market prices. MSP is much higher than A_2 costs for all states, which implies that the concept of risk coverage, the original justification for support prices, seems to be have been forgotten. By linking MSP and procurement, at very high cost, the present system is designed to guarantee income to farmers rather than to protect against the risk involved in introducing new growth-producing technologies.[3]

3.2.1.2 The Special Situation of Rice

There are two means by which rice arrives at the Central pool: levy rice procured directly by the government and 'custom-milled' rice (CMR) that is milled under custom-milling arrangements from paddy procured by FCI and other public agencies. Punjab is unique among states in that most of the rice procured in Punjab is paddy (Appendix Table A3.4a). However, of the paddy that is bought by millers, a statutory levy mandating a fixed portion (75 percent in the case of Punjab) of the milled rice be sold to the government is imposed. The average conversion ratio of rice from paddy is taken as 0.67. The levy price is based on average processing costs and the conversion ratio. Thus, rice millers are 'taxed', and cannot sell their remaining milled rice until the government portion is accounted for. Rice produced for export by export-oriented units or in export processing zones is exempted from the levy for the quantity that is exported (Government of Punjab 2006b).

[3] The increase in November 2006 of Rs 100 in the MSP for wheat to Rs 750 per quintal—a level that would be very difficult to decrease—is equivalent to approximately US$ 170 per ton. The government is thus locked into a domestic price level that is higher than the likely long-run price of US$ 130–140 per ton for wheat in the international market.

3.2.1.3 Procurement Levels

The level of procurement as a percentage of production increased during 1999–2000 to 2000–04 for both rice and wheat (Table 3.2). In 2003–04, 8.6 million tons of rice and 8.9 million tons of wheat were procured, representing 89 percent and 62 percent of total production, respectively. Punjab contributes a significant amount of rice and wheat to the Central pool. In 2003–04, the state accounted for 57 percent of national procurement of wheat and 38 percent of total rice, (Punjab's contribution of rice peaked in 2002–03 at 48 percent; see Appendix Tables A3.4a and A3.4b).

Table 3.2: Procurement and Production of Rice and Wheat in Punjab, 1999–2000 to 2003–04

Year	Rice			Wheat		
	October–September			April–March		
	Production (million tons)	Procurement (million tons)	% procured	Production (million tons)	Procurement (million tons)	% procured
1999–00	8.7	6.79	78	15.9	7.83	49
2000–01	9.2	6.93	75	15.6	9.42	60
2001–02	8.8	7.28	83	15.5	10.56	68
2002–03	8.9	7.94	89	14.2	9.88	70
2003–04	9.7	8.66	89	14.5	8.94	62

Source: GOI, *Economic Survey*, various years.

Markfed and PUNSUP account for 45 percent of the wheat procured in Punjab in 2004–05, while over two-thirds of paddy was procured by Markfed, PUNSUP, and Department of Food and Supplies (FOODSUP).

3.2.1.4 Regulated Markets

Wheat and paddy are procured in designated purchase centers or *mandis*. Over the years, the number of such purchase centers has grown rapidly. While there were 966 purchase centers for wheat and 841 centers for paddy in 1993–94, their number rose to 1,549 during the *rabi* season for wheat and 1,463 during the *kharif* season for paddy in 2004–05 (Government of Punjab 2006b). The Punjab State Agricultural Marketing Board (commonly referred to as the '*Mandi* Board') regulates its purchase centers through 145 Marketing Committees. The objective of this Board is to establish markets with infrastructure such as cemented or brick-lined auction platforms,

surfaced roads, electricity, water supplies, sewerage and drainage systems, and shelters for the farmers. The Board imposes a market fee of 2 percent on all purchase or sale transactions of agricultural products. In addition, it also collects a Rural Development Fund fee of 2 percent that is levied by the state government. All transactions relating to the sale and purchase of foodgrains are undertaken in these regulated markets only.

Purchases are made in regulated markets by auction with a view to encourage competition, enhance transparency, and give higher returns to farmers. The Marketing Committees appoint auctioneers and resolve disputes, if they arise. The foodgrains are purchased from the commission agent or the *kutcha arhtia*, whose task is to safeguard the interests of the seller. It is his responsibility to get the foodgrains unloaded, cleaned, and graded according to variety, moisture content, and foreign matter. The *kutcha arhtia* receives a commission for the services rendered by him, which is determined by the *Mandi* Board and is payable by the purchaser. All *kutcha arhtias* must obtain a license from the Marketing Committee. As their commissions are uniform, they compete with each other by providing services like the provision of short-term credit for purchase of inputs or for meeting the consumption or social needs of the farmer.

Procurement bottlenecks are common during the harvest season, due to inadequate facilities for storage and handling at *mandis*. The World Bank (1999) reported that during the harvest season in Amritsar and Jalandhar districts, farmers waited up to 17 hours outside the *mandi* to sell a tractor (2.4 tons) of grain and an additional 14 hours to sort out handling and payment. Storage is limited at *mandi* yards—just over 10 percent have covered facilities and just over 20 percent have concrete platforms to hold grain (World Bank 1999).

3.2.2 Distribution

The FCI undertakes the distribution of foodgrains through FPS and under various welfare and employment schemes run by the Government of India. PDS operations were mainly limited until the early 1970s to major urban areas and expanded in the mid-1970s to incorporate rural households. At present, the national PDS network consists of more than 462,000 FPS and distributes commodities worth more than Rs 300 billion annually to about 160 million families.

The expansion of the PDS included a number of important structural changes. In 1992, the PDS was re-organized as the Revamped Public Distribution System (RPDS), in

which subsidies were increased in tribal, drought-prone, and desert areas. A more radical change occurred in 1997, with the implementation of the TPDS. In this program, households were distinguished as being above the poverty line (APL) or below the poverty line (BPL), and special cards were provided to BPL households to enable them to receive foodgrains at lower prices than APL families. BPL families initially received an entitlement of 10 kg of foodgrains per month at a subsidized price; this was revised in 2000 whereby BPL foodgrains allocations were doubled to 20 kg and distributed at one-half the government's economic costs. The need to dispose of the rising stocks forced further changes to the system in 2001 and 2002. In early 2002, BPL allocations rose to 35 kg per household, with sales prices set at Rs 4.15 per kg for wheat and Rs 5.65 per kg for rice. The poorest-of-the-poor (Antyodaya) groups received foodgrains at an even lower price (Rs 2 per kg for wheat and Rs 3 per kg for rice), and prices for APL families were also reduced (USDA–FAS 2002).

The PDS in Punjab is represented through 13,645 FPS spread throughout the state. The PDS does not represent a significant source of consumption (well under 1.5 percent) for Punjabi households (see Table 3.3).

Table 3.3: Percentage of Consumption Obtained from the PDS in 1999–2000, Punjab and All-India

State	Rural		Urban	
	Rice	Wheat	Rice	Wheat
Punjab	1.3	0.5	0.9	1.4
All-India	12.1	4.9	12.9	7.0

Source: Government of India (2002c), as reported by Kaur (2004).

3.2.3 Buffer Stocks

The FCI is required to maintain buffer stocks to ensure national food security. Buffer stocks were well in excess of the norms during the early 2000s, as high levels of procurement combined with lower levels of PDS off-take contributed to a massive buildup of foodgrains stocks (see Appendices 3.5 and 3.6). By 2003–04, however, a combination of PDS leakages, higher PDS consumption, and subsidized exports brought stocks back to near normal levels. In the two years, i.e. 2005 and 2006, lower than average wheat production, lower procurement, and rising PDS consumption combined to lower buffer stocks for wheat and raise open market prices, which in February 2006 stood at Rs 950–1,000 per quintal for

milling wheat, well above the support price of Rs 650 per quintal established for 2005–06 (USDA–FAS 2006). As of March 28, 2006, FCI reported wheat stocks of 2.26 million tons, well below its April buffer norm of 4 million tons.

Foodgrains storage in India consists of either warehouse (*godowns*) or cover-and-plinth (CAP) in which bagged foodgrains are piled outside on a cement platform in a pyramid and covered with a plastic covering (World Bank 1999). In Punjab, the total storage capacity as of January 31, 2006 was 6.67 million tons. The majority of storage in the state is owned either by FCI or hired from state-level government agencies. The share of the private sector in foodgrains storage is small, with the private sector share of total storage capacity in the state at just over 6 percent.

In the case of paddy, state agencies do not hire storage space, as the paddy is stored in the premises of the rice mill allotted to the agency for custom- milling of paddy. The allocation of rice mills is undertaken by the state Department of Food and Supplies based on the milling capacity of the rice mill. The pace of delivery of both custom-milled and levy rice is guided by the milling capacity of the rice mills and the allocation of storage space by FCI. The FCI hires godowns for the storage of rice, unlike other state procuring agencies. Once the stocks are delivered to the FCI, the role of the other state agencies ceases.

Neither type of storage (covered or CAP) is very efficient from the standpoint of stock management. All paddy and wheat is stored in 95 kg jute bags, rather than using cheaper synthetic bags or bulk storage, which adds to handling costs and storage losses. The World Bank (1999) reported storage losses five times those of Indonesia, double those of Australia, and quadruple those of Canada. Stocks generally do not adhere to ‘first-in, first-out’ rules of management. Rather, stocks are moved into CAP storage last, but removed from CAP storage first to minimize losses from weather, pests, etc. Grain stocks are routinely fumigated every 15 days (adding to health risks) and in the past, stocks have been kept for lengthy periods. For example, the World Bank (1999) reported that 50 percent of stocks were at least two years old, with some grain stored for up to 16 years.

3.2.4 Concessions and Advantages of Public Sector in Marketing

The public sector receives numerous concessions and advantages. These are considered in detail below.

3.2.4.1 Transportation

The FCI receives priority for rail service, with most private sector trade conducted mainly through rented truck transport. The private sector receives only fourth priority on rail transportation, which limits private sector participation in railways to routes in excess of 500 km. While road transport is more expensive than rail transport, there may be benefits, including better service and lower levels of losses. However, costs of procurement, distribution, and non-market transactions costs must consistently remain below those of FCI for the private sector to profitably compete with FCI using non-rail forms of transport.

3.2.4.2 Storage

Storage limits imposed on private sector participants have been a feature of foodgrains management policy from the time the Essential Commodities Act (ECA) of 1955 was implemented. The rationale behind this policy was that hoarding and speculative behavior by private traders artificially raised prices. Restrictions on private sector storage under ECA were officially removed by the Central government in 2005, but continue to be invoked sporadically by many states. The ECA itself remains on the books, implying that the withdrawal of storage limitations is not necessarily permanent and could be re-imposed at any time (World Bank 2004).

Restrictions on storage notwithstanding, the profitability of private storage is undermined by price and stock policy. For storage to be profitable, there must be some degree of price variability so that the costs of storage are met. Puri (1996) found that only one-third of wholesale wheat markets and 22 percent of rice markets had seasonal price increases that met the cost of storage (defined as the ‘cost of working capital of 15 percent’). Indeed, the coefficient of variation of rice and wheat prices remained relatively low during the 1990s and early 2000s—in the period 1991–2004, the coefficient of variation for paddy and wheat prices was just 2.5 percent and 4.5 percent respectively.

3.2.4.3 Imports and Exports

Imports and exports of foodgrains are controlled by the public sector. The import and export volumes have been relatively erratic over the past several years, depending on the level of public buffer stocks. In the late 1990s, wheat imports were over 1 million tons per year due to the import of cheaper wheat from Australia and Europe by private flour millers either

through private channels or through government parastatals (USDA–FAS 1999, 2000). However, in December 1999, the GOI imposed a 50 percent tariff on wheat imports and reduced the sales price of domestically-procured wheat sold to wheat millers, ostensibly to reduce public stocks that were not being purchased by domestic millers (USDA–FAS 1999). In the early 2000s, sizable volumes of wheat and rice were sold overseas to dispose of the mounting stocks of foodgrains. The very low levels of wheat buffer stocks necessitated the import of 500,000 tons of wheat in early 2006 (USDA–FAS 2006).

3.2.4.4 Credit

The FCI receives favorable credit in terms of interest rates, repayment schedules, and ceilings. On food procurement credit, FCI has enjoyed interest rates 7 percent lower than private rates between 1972–73 and 1982–83, 5–6 percent lower until 1995–96 (Gulati and Kahkonen 1996), and 2–3 percent lower since 1997 (Jha and Srinivasan 2004). Moreover, no time limit in which it is required to pay off its credit obligations is imposed on the FCI, effectively reducing the interest rate paid over time. The private sector is limited in the amount of working capital it can borrow, under the rules of the Selective Credit Control (SCC) policy. The Reserve Bank of India (RBI) frequently revises interest rates and credit ceiling limits under the SCC, leading to increased uncertainty and risk for the private sector.

Evidence also suggests that the presence of FCI crowds out credit availability for other sectors and the private sector. The total volume of food credit in India has traditionally comprised a significant proportion of credit relative to other priority sectors, such as agriculture and small-scale industries (see Appendix Table A3.7). With the exception of 1988–90, food credit has consistently amounted to significant percentages of agricultural credit. Indeed, during 2000–02, total outstanding food procurement credit to FCI averaged Rs 470 billion, equivalent to 83 percent of total outstanding credit to both agriculture and small scale industries and an incredible 244 percent of total wholesale trade credit in the country.

3.2.4.5 Information

The private sector is constrained by lack of information. Quality standards for grain products do not provide any premiums for higher-quality products. Moreover, such norms change on an annual basis (World Bank 1999). Besides the MSP, limited price discovery or market information services are in place to support the grain sector, with government statistics and projections often delayed or unreliable (World Bank 1999).

3.2.4.6 Political Support

The scope of public intervention in the grain sector has created a sizable bureaucracy that has incentive to maintain the status quo given its rent-seeking abilities. With the increase in the degree of intervention, the size of FCI's workforce has increased over the years and currently stands at about 55,000 regular employees and over 170,000 casual employees. FCI's employees have not only increased in numbers but also gained in political clout, with the higher wage rates of FCI employees (FCI's regular employees earn 4–5 times more than market rates, while casual workers' daily wage is double the wage rates of rural Indian laborers) being a reflection of that power (Chand 2002). In addition, the grain management system has created a large group of stakeholders on the consumer side, including almost half a million ration shops, over 200 million ration cards, and more than 6,000 state marketing and regulatory agencies (including *mandi* boards).

3.3 Costs of the Public Foodgrains Management System

The costs of the foodgrains management system in India has increased significantly over the past five years, due in large part to the rising share of subsidies allocated to public storage (see Table 3.4). In 2001–02, the nominal food subsidy was nearly Rs 175 billion, of which nearly 34 percent was due to subsidies on storage, which nearly tripled between 1997–98 and 2001–02. While recent data on the share of storage in the total food subsidy bill are unavailable, recent declines in buffer stocks suggest that the share has declined. However, the total food subsidy bill has continued to increase in the wake of greater off-takes from the PDS.

Table 3.4: Trends in the Total Food Subsidy, 1999–2000 to 2005–06

Year	Total food subsidy (Nominal prices, Rs billion)	Total food subsidy (Constant 1993–94 prices, Rs billion)	Percentage share of food subsidy on storage
1997–98	79.00	57.77	12.49
1998–99	91.00	61.65	17.84
1999–2000	94.34	61.49	19.06
2000–01	120.60	75.96	35.24
2001–02	174.99	106.60	33.62
2002–03	241.76	141.35	NA
2003–04	251.60	142.84	NA
2004–05	258.00	139.55	NA
2005–06	262.00	NA	NA

Note: NA: Not available.
Source: GOI (2006), *Economic Survey, 2005–06*; Indiastat website www.indiastat.com, accessed March 17, 2006.

Leakages from the public distribution system also represent significant costs. Tata Economic Consultancy Services reported that nationwide 36 percent of wheat and 31 percent of rice was diverted from the PDS (cited in GOI 2002f). In Punjab, 69 percent of wheat and 40 percent of rice were reportedly diverted. National-level leakages in 1999–2000, estimated on the basis of the percentage of PDS supply not reported from the 55th Round of the National Sample Survey (NSS), were 19.7 percent for rice and 48.1 percent for wheat. There is frequent anecdotal evidence suggesting its broad scope and costs. For instance, a story published in August 2004 reported that government officials in Tamil Nadu seized 2,400 tons of rice that had been destined for the PDS in Tamil Nadu.[4]

A comparison of the costs of FCI's operations reveal that its per unit costs of distribution are higher than for the private sector, despite significant advantages in handling, freight, and credit. Gulati and Kahkonen (1996) showed that private margins in grain management were 9–10 percent, while FCI suffered losses of 29 percent for rice and 68 percent for wheat. Chand (2002) found that per unit trading costs of FCI for wheat were twice those of the private sector and 20 percent more for rice. Other estimates from Chand (2002) and Jha and Srinivasan (2004) reveal that as compared to the private sector, FCI's per unit storage costs are 30 percent higher, per unit labor costs are nearly four times higher for rice and seven times higher for wheat, and

[4] The full story is available at http://in.rediff.com/news/2004/aug/18rice.htm.

interest payments (even at favorable rates) four times higher for rice and 2.5 times higher for wheat.

Procurement and distribution costs of private traders in 1999–2000 were about 73 percent of those incurred by FCI in the case of wheat, with savings particularly on distribution costs (68 percent) (see Table 3.5). The private sector enjoyed a 10 percent cost savings over FCI. In the case of rice, all elements of costs incurred by private traders except freight and *mandi* charges were lower (see Table 3.6), with the private sector costs at 90 percent of FCI's costs when the recovery of rice bran and husk is accounted for. Lower distribution costs arise through economizing on handling expenses and storage charges. While the private sector is disadvantaged in terms of paying higher interest rates, shorter storage periods limit the total interest costs. When freight costs are excluded, the cost advantages of the private sector are even larger (83 percent of FCI's costs for wheat and 84 percent for rice in 1999–2000), as the private sector has to rely on more costly road transport. At the same time, the quality and reliability of service by private road transport makes up for some of the added costs, particularly when the problems encountered by FCI in rail transport (missing wagons, unconnected wagons, wagons reaching the wrong station, and railways charging diversion fees for sending them to the right destination) are considered.

Table 3.5: Comparison of Costs of Wheat Operations of Private Traders in Punjab and FCI, 1999–2000

Element of cost	FCI (Rs per quintal)	Private trade (Rs per quintal)	Private costs as % of FCI costs
Procurement costs	125.49	101.5	80.9
Distribution costs	193.97	131.67	67.9
Total costs	319.46	233.17	73
Economic cost	869.46	783.17	90.1
Total economic cost excluding freight	*795.80*	*663.17*	*83.3*

Source: Kaur (2004).

Table 3.6: Comparison of Costs of Rice Operations of Private Traders in Punjab and FCI, 1999–2000

	FCI (Rs per quintal)	Private trade (Rs per quintal)	Private costs as % of FCI costs
Procurement costs	149.59	112.05	74.9
Distribution costs	191.51	145	75.7
Milling charges (paddy)	13.8	14	
Recovery from sale of bran/husk	0	29.6	
Economic cost of rice (per quintal)	1,086.24	972.79	89.6
Economic cost of rice excluding freight	*1,012.58*	*852.79*	*84.2*

Source: Kaur (2004).

3.4 Assessment of Underlying Rationales for Public Foodgrains Management: Is There Still a Role for FCI?

The rationales traditionally provided for intervention in grain markets have typically been four-fold: limited market integration across space, protecting farmers from the risks inherent in new technology promotions (for example, Green Revolution varieties), limited institutional infrastructure to deal with volatile world grain markets, and foreign exchange constraints. While these rationales were potentially valid in the past, over time their validity has diminished.[5]

Limited integration of markets across space was a significant constraint in the 1950s and 1960s. In particular, road and communications infrastructure was lacking, resulting in localized price shocks in deficit regions. However, the last 30 years has witnessed a major improvement in infrastructure. For instance, the paved road network in the country quadrupled from 334,000 km in 1970 to 1.363 million km in 2000. Access to telephones, radios, and televisions also increased. In 1970, just one person in 370 had a telephone, one in 20,000 a television, and one in 32 had a radio. By 2000, these figures rose to one in 5, one in 3, and one in 2, respectively.[6] Mobile phone access has likewise increased rapidly, even in rural areas. Empirical evidence assessing the spatial integration of markets in India is mixed, though none of these studies suggest that Indian foodgrains markets are spatially disintegrated over the long

[5] This section borrows from Rashid, Cummings and Gulati (2005).
[6] All household level calculations are based on the assumption that an average household consists of five members and that the ownership distribution is normal.

run from the mid-1980s onward and disintegration over the short-run is associated with government-imposed movement restrictions.

The second rationale—protecting farmers in the adoption of new technology—was a major issue in the 1960s when HYVs were being introduced, particularly in an environment characterized by high levels of market risk. Indeed, the significant rise in production engendered by HYVs in 1967 prompted policy-makers to establish floor prices and invest in storage to handle the transition towards HYVs. However, given that HYVs now cover almost all cropped area under rice and wheat in Punjab, it is difficult to argue that price supports are required to promote such varieties.

The bias against relying on import markets is steeped in India's desire to attain self-sufficiency in food production. Indeed, it was argued that thin world markets for foodgrains were too risky to be counted on, while India's standing as a large country could destabilize world grain markets. These arguments no longer hold. Public policy and technology gains have led to a quadrupling of foodgrains production and India is now an infrequent exporter of grain. Moreover, the supply–demand balance projected in the future is such that supply will likely outstrip demand, particularly as income growth leads to a deceleration in grain demand. Bansil (2003) predicts that total demand for foodgrains by 2020 will not exceed 241 million tons, while from the standpoint of supply, Kumar and Mittal (2003) projects volumes between 248 million and 290 million. This implies that India will remain at least a marginal net exporter of foodgrains in the coming decades.

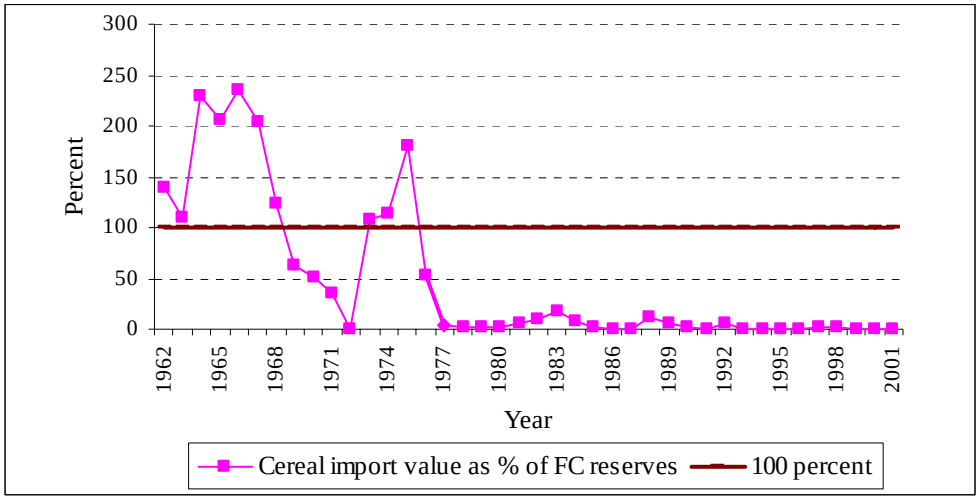
World markets for grain have evolved from the standpoint of traded volumes and price volatility (Rashid, Cummings and Gulati 2005). While world prices tend to be more unstable than domestic markets (mainly due to the price supports in place), the volatility of world prices for rice and wheat has declined in the past two decades, particularly in the 1990s. For instance, in the case of rice, traded volumes have increased from seven million tons in the late 1960s to more than 25 million tons in the past few years, while the average change in the absolute value of annual rice prices declined from 24 percent during 1965–81 to just 11 percent during 1985–98 (Dawe 2002).

Finally, foreign currency constraints that existed in the 1960s and 1970s are no longer binding. Cereal import values exceeded foreign currency reserves[7] in the 1970s (see Figure 3.4). India's experience in the 1960s, when drought affected foodgrains production and foreign exchange reserves were low, demonstrated the link between

[7] Cereal import includes government import, food aid, and other commercial imports. Foreign currency reserve does not include gold value, Special Drawing Rights (SDRs), and fund with the IMF.

foreign currency reserves and food security and provided motivation for policies aimed at accelerating production and self-sufficiency in food. However, the raison d'être for such policy does not exist anymore. In June–July 2004, total foreign currency reserves in India were US$ 120 billion,[8] while rice was selling in the world market at US$ 185 per ton. This implies that, *ceteris paribus*, only four percent of the Indian foreign currency reserves would be required to buy all 25 million tons of rice available in the world market.

Figure 3.4: Cereal Import Values as a Percentage of Foreign Exchange Reserves, 1965–2001



Source: Rashid, Dev, Thomas and Gulati (2005).

Clearly, neither the domestic nor the international situations that justified the role of public sector intervention in the grain sector in the 1950s and 1960s hold today. The grain management system at present induces significant inefficiencies in the procurement, distribution, and storage of grain that account for rising costs in the form of food subsidies. Increased private sector participation would significantly contribute to raising efficiency and lowering costs, as demonstrated in the previous section.

[8] Foreign currency reserves stood at $193 billion in February 2007.

3.5 Prospects for Private Sector Marketing

Private sector marketing performs remarkably well, given the conditions under which it has to operate. Movement and storage controls under the (ECA and various state-mandated edicts have traditionally restricted private sector activities in procurement and distribution. Movement controls on foodgrains were lifted in 2002, but, as stated earlier, the ECA remains in effect, allowing for the possibility of re-imposition (World Bank 2004). In 2006, states were given back the power to control such movement.

A further constraint on private sector involvement have been restrictions imposed by the Agricultural Produce Marketing Committee (APMC) Act that require all sales to go through regulated markets rather than directly between farmers and buyers (for example, processors, millers). This ban on direct sales stifles innovation and incentives for quality, as buyers cannot work with farmers to grow specialized varieties or utilize specific practices. Moreover, the FAQ standards set by the government do not provide price incentives for farmers to exceed established quality norms. As a consequence, millers are forced to rely on the quality of grain delivered to the market at the time of purchase, resulting in poor quality flour and higher costs to clean and process. The World Bank (1999) estimated up to 6 percent of wheat milled by flour millers as waste. The 50 percent duty imposed on wheat imports raises prices for consumers and also limits the quality of wheat available to millers to that which is domestically available.

In addition, bans on direct sales prevent large-scale investment in the sector by the private sector, particularly by milling companies that place a premium on procuring large volumes of high quality products that the current system cannot guarantee. This is evidenced by the small-scale nature of the milling industry at present. In terms of volume, the wheat milling industry is dominated by small-scale *chakkis* that number over 26,000 and account for 85 percent of the wheat milled in India (World Bank 1999). There are about 1,000 larger-scale operations with a total capacity of 24 million tons, but operating capacity remains low at 50 percent (USDA–FAS, *India: Grain and Products Annual, 2006*). By contrast, wheat milling operations in the United States typically operate at 80 percent capacity or more. Rice milling also remains small-scale, despite the removal of the Rice Milling Act, which mandated that milling had to be conducted in small-scale facilities, and the provision of tax incentives for large-scale mills in certain states (World Bank 1999). Rice milling is further hampered by levy requirements that prevent millers from selling in the open market until levy requirements have been satisfied. This creates an environment where corruption has become endemic, since millers have incentive to bribe officials to bring rice illegally

into the open market where market prices are well above levy prices. Likewise, technology in the milling sector remains low and hampered by under-investment, with few large-scale players available to improve industry-level technology. Recovery rates for wheat and rice milling are well below international standards—60–65 percent for wheat and 50–68 percent for paddy, compared to 70+ percent each for wheat and paddy in developed countries (see World Bank 1999).

In 2003, the Government of India tabled a model APMC Act that reforms a number of marketing restrictions presently in place, including the ban on direct marketing. In Punjab, certain reforms have been undertaken. For instance, the Punjab government has redefined its definition of market yards to include private yards that have received a license from the state government. Wheat millers are further exempted from the assessment of market fees for the purchases of wheat for processing purposes (flour and food processing). These reforms are an important first step to allow direct sales between farmers and buyers, though the transparency of the process to obtain licenses to establish private market yards remains unclear.

Traditional arguments for state-led control of international trade revolve around the ability of government to achieve lower prices by negotiating with and buying from sellers in bulk. However, historical data demonstrate that the public sector has actually paid *higher* prices than the world price. Recent experience in Bangladesh, where the private sector was allowed to import from the mid-1990s, demonstrates that the private sector can operate more efficiently; during the flood of 1998, despite larger consignments by the government, the government paid higher prices and took more time to complete its import procedures than the private sector (Ali and Jahan 2003).

The existence of large buffer stocks and the public distribution system further crowd out private sector participation in the distribution of foodgrains. While the private sector is active in small-scale retail and wholesale activities, the combination of open market sales to stabilize prices combined with leakages and theft from the public distribution system reduce the profitability of private sector participation. The private sector is particularly hampered by the uncertainty surrounding the volume of open market sales, which hampers planning and consequently involvement in the sector. Over the past five years, open market sales varied from a high of 5.661 million tons in 2002–03 to a low of 247,000 tons in 2004–05 (see Appendix Table A3.8). The depressing effect of such sales on prices and their erratic pattern over time complicates private sector participation.

3.6 Concluding Remarks

The public foodgrains management system in Punjab has evolved in such a way that production of wheat and rice has been accelerated by the government contracting wheat and rice at high, stable prices, and foodgrains security has been assured in the state and throughout the country by making more grain available, including through public distribution. However, in the process, providing an assured market for wheat and rice at prices higher than full costs (including imputed costs for labor and land) has led to farmers devoting as much land to growing as much wheat and rice as they can, taking incentives away from growing high-value commodities (HVCs must make even higher average returns than wheat or rice to compensate for the higher transactions costs and greater risks). Until recently, often with production in the state constrained due to movement restrictions, MSP has been above the 'market' price. Thereby FCI has pre-empted the market, leaving less scope for the private trade to operate and develop. The existing market rules and regulations favor foodgrains and the public management system that buys and sells the foodgrains; different rules and regulations are needed to promote high-value commodities. Since the private trade has limited (but safe) business, it has little incentive to invest. Since wheat and rice dominate the market, the state and Central governments have little incentive to invest in infrastructure that would be more suitable to support high-value agriculture. And the system perpetuates because many stakeholders benefit—stakeholders including wheat and rice farmers, traders in the market, and the staff of the FCI, and operators of PDS.

However, the costs of the public procurement, distribution, and buffer stock system have increased markedly. The country's stocks for public distribution and buffer have fluctuated from historic highs to historic lows. While there is lesser rationale for public intervention now, the private marketing system, which would most likely perform most tasks at least as effectively as and probably more efficiently than the public system, is inhibited. Diversification to high-value commodities is also hampered.

Appendix Table A3.1: Minimum Support Prices and CACP Recommended Prices for Wheat and Paddy, 1995–96 to 2004–05

Crop year	Wheat (Rs per quintal)		Paddy (Rs per quintal)			
	MSP	CACP	MSP (Common)	CACP (Common)	MSP (Fine)	MSP (Super fine)
1995–96	360	360	360 +5	355	375 + 5	395 +5
1996–97	380	380	380	370	395	415
1997–98	415 + 60 (Bonus) = 475	405	415	415		445
1998–99	455 + 55 (Bonus) = 510	455	440	440		470
1999–2000	550	490	490	465		520
2000–01	580	550	510	510		540
2001–02	610	580	530	520		560
2002–03	620	620	530 + 20 (DR)	530		560 + 20 (DR)
2003–04	620 + 10 (DR)	620 + 10 (DR)	550	550		580
2004–05	640	640	560	560		590

Note: DR: drought relief.
Source: Department of Food and Supplies, Government of Punjab website http://foodsuppb.nic.in/proc.htm, accessed November 2, 2005.

Appendix Table A3.2: Costs (C_2 and A_2) and Cumulative Percentage Production of Selected States: Wheat

States	Costs (Rs per quintal)				Percent production	Cumulative percent production
	2000–01	2001–02	2002–03	TE (2002–03)		
			C_2			
Punjab	432.1	455.6	493.8	460.5	23.0	23.0
Haryana	454.3	476.0	477.8	469.4	14.4	37.5
Uttar Pradesh	445.9	454.7	507.7	469.4	37.8	75.3
Rajasthan	507.8	464.6	482.2	484.9	8.6	83.9
Bihar	490.6	545.7	602.9	546.4	6.6	90.4
Gujarat	582.6	519.2	588.2	563.3	1.4	91.8
Madhya Pradesh	588.9	590.8	654.1	611.3	7.5	99.3
Himachal Pradesh	935.3	736.6	703.4	791.8	0.7	100.0
			A_2			
Haryana	211.3	227.2	243.3	227.3	14.4	14.4
Rajasthan	233.7	224.5	233.8	230.7	8.6	23.0
Punjab	227.4	245.8	268.6	247.3	23.0	46.0
Uttar Pradesh	234.0	241.6	274.0	249.9	37.8	83.9
Madhya Pradesh	297.0	310.2	342.6	316.6	7.5	91.4
Bihar	281.5	322.7	349.1	317.8	6.6	98.0
Himachal Pradesh	386.9	295.9	276.8	319.9	0.7	98.6
Gujarat	341.4	308.6	362.6	337.5	1.4	100.0

Source: Production figures have been computed using data from CMIE (2005); Costs figures have been taken from Government of India, *Reports of the Commission for Agricultural Costs and Prices*, 2004 and 2005.

Appendix Table A3.3: Costs (C_2 and A_2) and Cumulative Percentage Production of Selected States: Paddy

States	Costs (Rs per quintal)					
	2000-01	2001-02	2002-03	TE (2002-03)	Percent production	Cumulative percent production
			C_2			
Punjab	386.29	392.91	498.12	425.8	12.4	12.4
Bihar	451.52	430.33	484.08	455.3	7.2	19.6
Uttar Pradesh	414.84	447.37	528.88	463.7	15	34.6
Orissa	477.04	433.05	539.53	483.2	6.9	41.5
Assam	470.3	495.29	504.89	490.2	5.3	46.8
West Bengal	499.67	499.67	549.06	516.1	19.4	66.2
Andhra Pradesh	496.59	538.35	543.71	526.2	14.3	80.5
Karnataka	478.81	590.41	603.57	557.6	4.3	84.8
Tamil Nadu	509.61	567.74	615.1	564.2	9	93.8
Haryana	558.06	596.03	682.86	612.3	3.6	97.4
Kerala	615.78	597.91	630.19	614.6	1	98.4
Madhya Pradesh	704.06	592.74	690.26	662.4	1.6	100
			A_2			
Assam	205.2	221.35	206.44	211	5.3	5.3
Punjab	207.5	211.87	296.21	238.5	12.4	17.7
Uttar Pradesh	207.4	282.97	231.03	240.5	15	32.7
Bihar	239.2	220.38	264.74	241.4	7.2	39.9
Orissa	245.8	226.23	290.15	254.1	6.9	46.8
West Bengal	251.4	264.19	296.52	270.7	19.4	66.2
Andhra Pradesh	272.4	305.02	294.88	290.8	14.3	80.5
Haryana	280.5	295.9	381.41	319.3	3.6	84.1
Karnataka	289.7	378.85	376.77	348.4	4.3	88.4
Tamil Nadu	326.3	362.53	374.19	354.3	9	97.4
Madhya Pradesh	377.4	314.63	380.11	357.4	1.6	99
Kerala	448.7	436.28	455.65	446.9	1	100

Source: Production figures have been computed using data from CMIE (2005); Costs figures have been taken from Government of India, *Reports of the Commission for Agricultural Costs and Prices*, 2004 and 2005.

.

Appendix Table A3.4: Contribution of Punjab to All-India Procurement for the Central Pool, 1999–2000 to 2003–04

(a) Rice and Paddy (October–September)

Year	All-India procurement of rice (million tons)	Punjab procurement of rice (million tons)	All-India procurement of paddy (million tons)	Punjab procurement of paddy (million tons)	All-India procurement of levy rice (million tons)	Derived Punjab procurement of levy rice (million tons)
1999–2000	17.31	6.79 (39)	9.19	8.28 (90)	11.15	1.24 (11)
2000–01	19.59	6.94 (35)	11.79	8.70 (74)	11.69	1.11 (9)
2001–02	22.13	7.28 (33)	14.7	9.43 (64)	11.43	0.97 (8)
2002–03	16.41	7.94 (48)	14.47	10.36 (72)	6.72	0.99 (15)
2003–04	22.83	8.66 (38)	16.65	9.86 (59)	11.67	2.06 (18)

(b) Wheat (April–March)

	All-India procurement (million tons)	Punjab procurement (million tons)	% procured from Punjab
1999–2000	14.14	7.831	55
2000–01	16.35	9.424	58
2001–02	20.63	10.560	51
2002–03	19.05	9.880	52
2003–04	15.80	8.938	57

Note: Figures in parentheses show percentage procured from Punjab.
Derived levy rice is calculated as the residual between total rice procurement and paddy procurement converted to rice equivalent using a conversion rate of 0.67. Actual figures for levy rice procured from Punjab for FCI are available for 1999–2000 to 2001–02 and are 1.274 million tons (1999–2000), 1.182 million tons (2000–01), and 0.961 million tons (2001–02), quite close to the derived figures presented above. For consistency, however, we use the derived figures in Table 3.4(a) above.
Source: GOI, *Economic Survey 2005–06*; Government of India, *Agricultural Statistics at a Glance*, 2000 and 2005.

Appendix Table A3.5: Buffer Stocks of Rice with the Central Pool in India, 1999–2000 to 2005–06

(in million tons)

	Beginning of the month of							
	April		July		October		January	
	Norm	Actual	Norm	Actual	Norm	Actual	Norm	Actual
1999–2000	11.8	12.16	10	10.56	6.5	7.74	8.4	14.72
2000–01	11.8	15.72	10	14 .49	6.5	13.21	8.4	20.70
2001–02	11.8	23.19	10	22.75	6.5	21.45	8.4	25.62
2002–03	11.8	24.91	10	21.94	6.5	15.77	8.4	19.37
2003–04	11.8	17.16	10	10.97	6.5	5.24	8.4	11.73
2004–05	11.8	13.07	10		6.5		8.4	
2005–06	12.2	13.3	9.8	10.1	5.2	4.8	11.8	

Source: GOI, *Economic Survey*, various years.

Appendix Table A3.6: Buffer Stocks of Wheat with the Central Pool in India, 1999–2000 to 2005–06

(in million tons)

	Beginning of the month of							
	April		July		October		January	
	Norm	Actual	Norm	Actual	Norm	Actual	Norm	Actual
1999–2000	4	9.66	14.3	22.46	11.6	20.31	8.4	17.17
2000–01	4	13.19	14.3	27.76	11.6	26.85	8.4	25.04
2001–02	4	21.5	14.3	38.92	11.6	36.83	8.4	32.42
2002–03	4	26.04	14.3	41.07	11.6	35.64	8.4	28.83
2003–04	4	15.65	14.3	24.19	11.6	18.43	8.4	12.69
2004–05	4	6.93	14.3		11.6		8.4	
2005–06	4	4	17.1	14.5	11	10.3	8.2	

Source: GOI, *Economic Survey*, various years.

Appendix Table A3.7: Comparison of Gross Bank Credit (outstanding) to Priority Sectors

Period	Total gross credit to priority sectors				Food procurement credit as percentage of:		
	Agriculture	Small-scale industries	Wholesale trade*	Food credit**	Agriculture	Small-scale industries	Wholesale trade
	(million US$)				(percent)		
1979–81	4,365	3,895	2,446	2,396	57	63	98
1982–84	5,947	5,157	2,309	3,907	65	75	171
1985–87	8,312	7,287	2,564	3,402	43	49	136
1988–90	9,631	9,327	3,291	1,416	15	15	43
1991–93	6,898	7,054	2,375	2,529	37	36	107
1994–96	8,193	9,486	3,387	2,992	37	32	90
1997–99	9,682	11,806	3,586	4,428	45	37	123
2000–02	12,053	12,126	4,098	10,036	83	83	244

Note: * Wholesale trade credit excludes the credit disbursed for food procurement
**Food credit refers to total food procurement credit.
Source: Authors' calculations based on data from Reserve Bank of India (2002b).

Appendix Table A3.8: Volume of Open Market Sales in Foodgrains (Rice and Wheat) in Punjab, 1999–2000 to 2004–05

Year	Open market sales (million tons)
1999–2000	4.551
2000–01	1.488
2001–02	5.598
2002–03	5.661
2003–04	1.33
2004–05	0.247

Source: Department of Food and Public Distribution, Ministry of Consumer Affairs, Government of India.

Chapter 4
Input Subsidies

The total input subsidy in Punjab in TE 2003–04 was Rs 26,907 million, of which 60 percent was due to electricity alone (see Table 4.1).[1] Fertilizer subsidy represented another 37.6 percent of the total input subsidy and irrigation subsidy was a relatively small part of the total (2.8 percent).[2] Put into perspective, total input subsidies accounted for about 10.2 percent of the GSDP originating from agriculture and allied activities in the state and perhaps two times the combined public capital and current expenditures by the state government. Subsidies averaged Rs 6,769 per ha of cropped land, and over 15 percent of the average net profits of wheat–rice rotation.

Table 4.1: Total Input Subsidies in Punjab: TE 2003–04

Input subsidy	Amount (Rs million)	Share (%)	Per ha (Rs)
Fertilizer	10,107	37.6	2,542
Electricity	16,055	59.7	4,039
Irrigation	745	2.8	187
Total	26,907	100.0	6,769

Source: Vashishtha and Gupta (2006).

Input subsidies arguably made a positive contribution to production during the early years of the Green Revolution when wheat and rice technologies were new, fertilizer

[1] To estimate subsidies on fertilizers, irrigation, and power, we adopted the approach used by Gulati and Narayanan (2003). Broadly, the fertilizer subsidy is measured as the difference between import parity price (adding c.i.f. price, pool handling expenses, and dealer's margin) and what the farmer actually pays, multiplied by the total consumption of fertilizers. Irrigation and power subsidies are measured as implicit payments made by the state government to the service providers. While the irrigation subsidy is wholly provided as budgetary support, the power subsidy is partly financed through cross-subsidization. The irrigation subsidy is measured as the excess of operation and maintenance (O&M) expenses over receipts from the farmers as canal irrigation charges. The calculated subsidy does not include a charge for amortization of the capital costs of constructing the irrigation systems (which, if included, would make the subsidy very high indeed). The power subsidy is estimated as the difference between the average cost of production per unit and the average revenue realized per unit, multiplied by agricultural power consumption. See Gulati and Narayanan (2003) for more detail on methodology of definition and measurement.

[2] The irrigation and electricity subsidies are Punjab state government responsibilities while the fertilizer subsidy is a Central government responsibility.

use was low, and irrigation was not so extensive. These subsidies have been felt by many as justified to offset the downward pressures applied to commodity prices.[3]

However, the conditions that justified the subsidies no longer hold. Their costs have increased while their benefits have declined. In particular,

- Nitrogen fertilizer is being applied at levels above those recommended, nutrient use is imbalanced, and water is being applied freely and uneconomically.
- Surface irrigation has not been receiving the necessary operations and maintenance and the State Electricity Board is being bankrupted, non-agricultural power users are losing competitiveness, and the ability to provide quality power is being inhibited.
- The subsidies are accentuating regional (the central region is getting the largest proportion) and personal (the people for whom subsidies are often justified, the smallholders, are not the principal beneficiaries) income disparities.
- Subsidized fertilizer, canal irrigation, and power are being applied disproportionately to wheat and, especially, rice, giving these crops large cost advantages compared to high-value commodities.
- Waterlogging and salinity are increasing steadily in the south west cotton region, causing increasing tracts of canal-irrigated land to go out of production. The water table is falling rapidly in the central region, necessitating deepening of tubewells and installing of larger motors to pull up the remaining groundwater.
- Scarce budget resources are being siphoned away from more productive investments.

It is time to have a rethink on agricultural subsidies. This chapter describes the nature of the subsidies and analyzes some of the economic, institutional, and environmental problems that have surfaced.

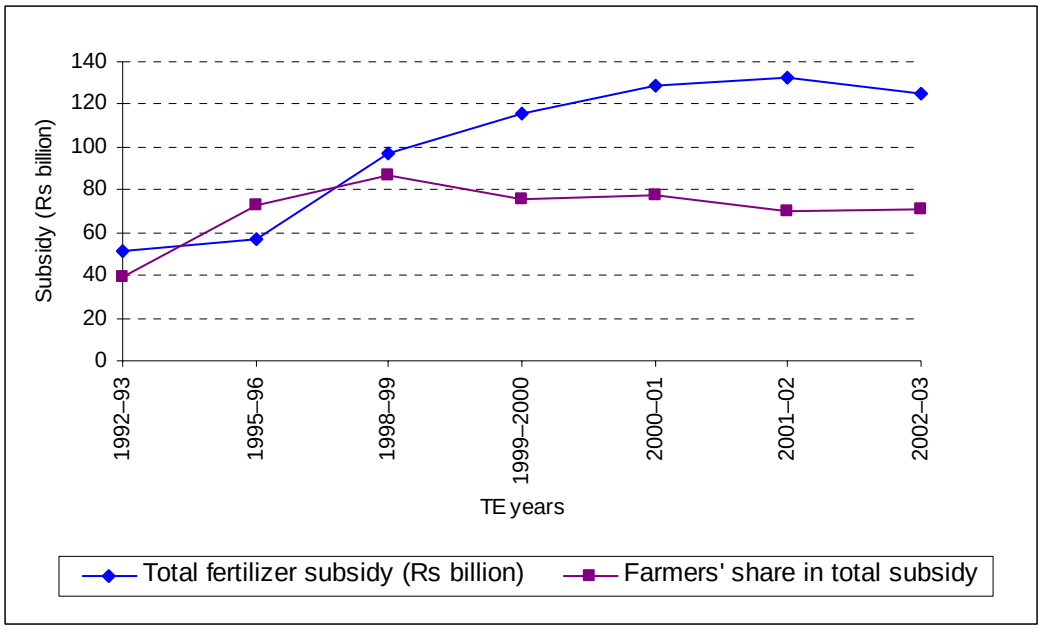
4.1 Fertilizer Subsidies

The genesis of fertilizer subsidy lies in the scheme of administrated prices of fertilizer, known as the Retention Price Scheme (RPS) (Gulati and Narayanan 2003; Mehta 2005). Trends of the subsidies placed on each type of major fertilizer are shown in Appendix Table A4.1.

[3] Indian agriculture policy has been characterized as ‘one foot on the brake and one foot on the accelerator’.

The farmer's share of total fertilizer consumption relative to that of the fertilizer industry varies annually depending on the relative magnitude of the import price, the retention price, and the farm-gate price announced by the GOI. Farmer's share in subsidy declined significantly from 1995–96 through 2002–03—from 127.8 percent in 1995–96 to 57 percent in 2002–03 (see Figure 4.1 and Appendix Table A4.2). Thus, it is clear that the RPS supports a very inefficient domestic fertilizer industry.

Figure 4.1: Total Fertilizer Subsidy and Farmers' Share in Total Fertilizer Subsidy in India



Source: Fertilizer subsidies from GOI, *Economic Survey*, various years; farmer's shares are from Vashishtha and Gupta (2006).

The subsidies on nitrogen fertilizer have led to decrease in efficiency and decline in sustainability due to deterioration of soil fertility and greater use of water.

4.1.1 High Levels of Nitrogen Usage

The application of total fertilizer [nitrogen–phosphorus–potassium (NPK)], especially N, on both wheat and rice is above the recommended levels (see Table 4.2).

Table 4.2: Estimated and Recommended Levels of Fertilizer Application on Wheat and Rice, TE 1992–93 to TE 2003–04

Year (TE)	Estimated level of fertilizer application (kg per ha)				Recommended average fertilizer level (kg per ha)			
	N	P	K	NPK	N	P	K	NPK
				Wheat				
1992–93	137.3	57.5	2.3	197.1	125.0	62.5	30	217.5
2003–04	157.9	64.9	4.9	227.6	125.0	62.5	30	217.5
				Rice				
1992–93	156.4	34	2.5	192.9	125	30	30	185
2003–04	163	23	2.3	188.3	125	30	30	185

Source: Vashishtha and Gupta (2006).

4.1.2 Imbalanced NPK Ratio

The NPK ratio for wheat is highly distorted in favor of N (see Table 4.3). The distortion in favor of nitrogen on rice is much larger than in wheat.

Table 4.3: Farmers' Applications and Recommended Ratios of NPK on Wheat and Rice, TE 2003–04

Farmer Application Ratio N:P:K			Recommended Ratio N:P:K		
N	P	K	N	P	K
32.2 (2.4)	13.2	1	4.2 (2)	2.1	1
70.9 (7.1)	10	1	4.2 (4.2)	1	1

Note: N/P ratio in parentheses.
Source: Vashishtha and Gupta (2006).

4.1.3 Micronutrient Deficiencies

Almost half of Indian soil is deficient in zinc (Zn) and one-third in boron (B). Parts of the Indian soil are deficient in iron (Fe) too. Punjab's soils are deficient in zinc prominently (48 percent) and in iron (12 percent). Due to intensive wheat and rice production the soils are being mined of micronutrients, increasing their deficiencies (Aulakh and Bahl 2001).

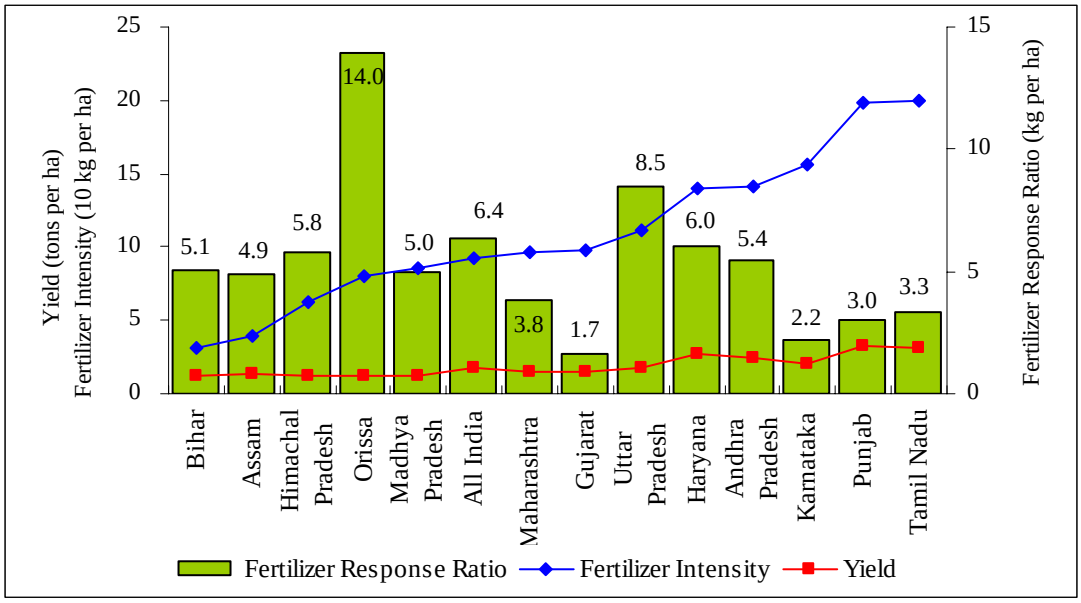
4.1.4 Declining Fertilizer Response

Figures 4.2 and 4.3 depict the response ratio and the corresponding fertilizer intensity for wheat and rice for all-India. Some observations based on these figures are noteworthy:

(i) For states with higher yields than the all-India level, the response ratio is falling with a rise in fertilizer intensity.

(ii) From states described in (i) above, Punjab has the highest yield for rice as well as wheat and also the highest fertilizer intensity for these crops but its fertilizer response ratio is quite low, though not necessarily the lowest.

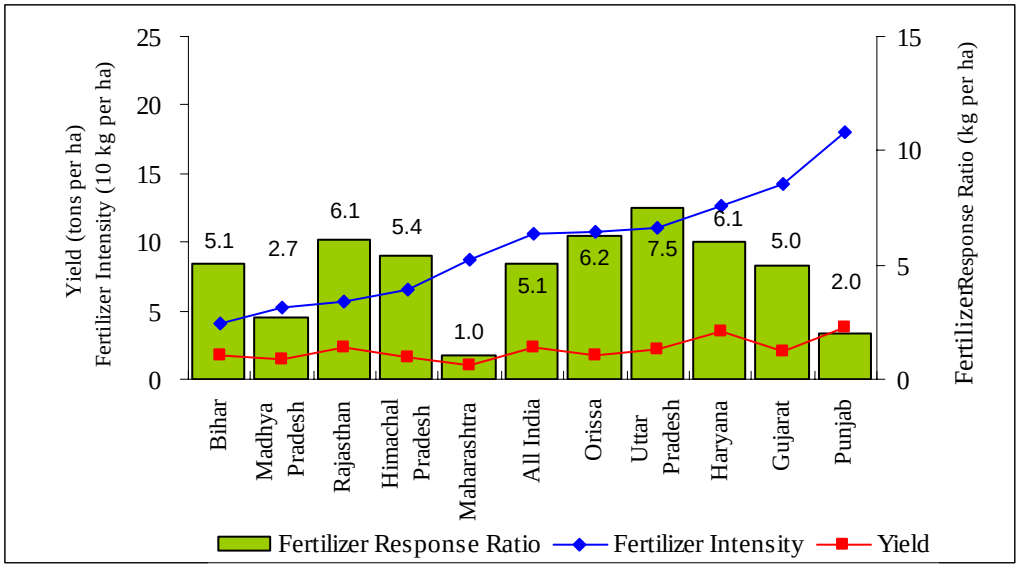
Figure 4.2: Yield, Fertilizer Response Ratio, and Fertilizer Intensity for Different States: Rice



Note: Yield figures are for 1990–91; Fertilizer Intensity and Fertilizer Response Ratio figures are for 2000–01.

Source: Fertilizer Response Ratios are taken from Indian Council of Agricultural Research (2001); yield (1990–91) figures are taken from Government of Punjab, *Statistical Abstract of Punjab*, various years; Fertilizer Intensity is computed by authors using data from The Fertiliser Association of India (2005).

Figure 4.3: Yield, Fertilizer Response Ratio, and Fertilizer Intensity for Different States: Wheat



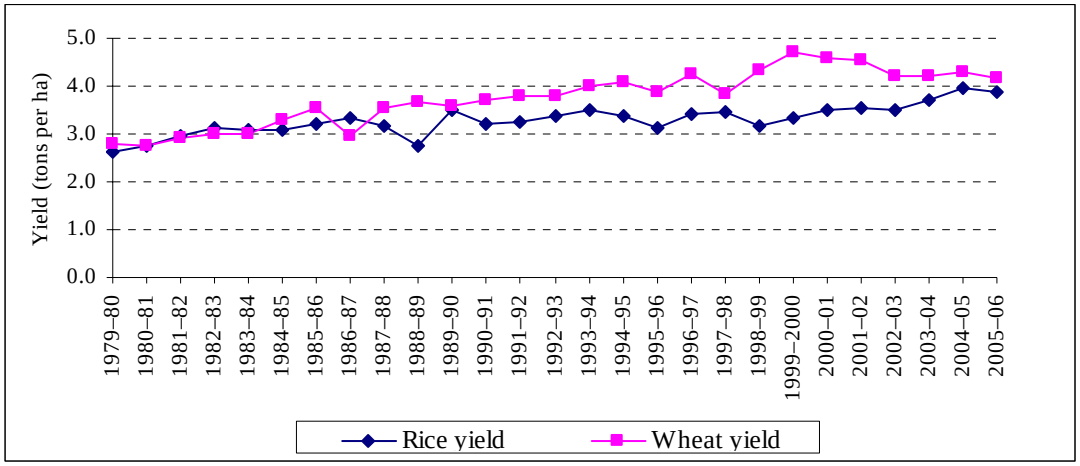
Note: Yield figures are for 1990–91; Fertilizer Intensity and Fertilizer Response Ratio figures are for 2000–01.

Source: Fertilizer Response Ratios are taken from Indian Council of Agricultural Research (2001); yield (1990–91) figures are taken from Government of Punjab, *Statistical Abstract of Punjab*, various years; Fertilizer Intensity is computed by authors using data from The Fertiliser Association of India (2005).

4.1.5 Deceleration in Yields

The growth in yield of wheat was 2.42 percent in the 1970s and 2.96 percent in the 1980s but only 1.96 percent in the 1990s (Figure 4.4, Table 4.4). In the four years 2002–03 to 2005–06, the mean yield of wheat decreased.

Figure 4.4: Yields of Paddy and Wheat in Punjab, 1979-80 to 2005-06



Source: Government of Punjab, *Statistical Abstract of Punjab*, various years.

Table 4.4: Yield Levels, Growth Rates, and Volatility of Yields of Rice and Wheat in Punjab

Average yields (kg per ha)		
	Rice	Wheat
TE 1982–83	2,942	2,888
TE 1989–90	3,148	3,600
TE 1999–00	3,322	4,293
TE 2005–06	3,832	4,223
Exponential growth of yield (%)		
	Paddy	Wheat
1970s*	3.8	2.4
1980s	1.3	3.0
1990s	0.02	2.0
2001–06	2.9	-1.4
Note: Growth rates are based on exponential logarithm		
Volatility of yield (%)		
	Paddy	Wheat
1970s*	14.2	9.7
1980s*	7.5	10.4
1990s*	3.9	7.6
1990–2004	4.7	7.6

Note: * Calculated from different, although comparable, data series; Volatility is measured by Coefficient of Variation.
Source: Government of Punjab, *Statistical Abstract of Punjab*, various years; authors' calculations.

Since 1980–81 three new varieties of wheat have been released, of which the most successful variety, released in 1998–99, has been PBW 343. This variety gives the highest yield (4,487 kg per ha) in the rice–wheat cropping system and also gives a better response to fertilizer than the earlier popular wheat varieties (Singh et al. 2004). About 86 percent of area of wheat at present is under PBW 343.

The stability of yield of wheat was higher in the 1990s than in the 1980s with the coefficient of variation (CV) of yield being 7.5 percent and 10.4 percent, respectively, in the two periods (coefficient of variation of wheat yield in the 1970s was 9.7 percent).

While the annual growth rate of yield of paddy in the 1970s was much higher (3.8 percent) than that of wheat (2.4 percent) the growth rate of paddy fell substantially in subsequent years in the 1980s and 1990s. In fact, in the 1990s it was not significant, i.e. the growth rate of 0.02 percent in the 1990s was statistically not different from zero. During 2003–06, paddy yields showed some increase.[4]

One redeeming feature of paddy yield is that in spite of virtually zero growth rate in the 1990s, the stability (CV=3.9 percent) was higher than in the 1980s (CV=7.5 percent) (see Table 4.4c).

4.1.6 Efficiency and Sustainability

Punjab has reached a low level of fertilizer response ratio with high level of yield and fertilizer intensity. If one considers both the major cereal crops together (rice and wheat), Punjab seems to be reaching the situation where stagnation in yield level and decline in fertilizer response ratio has already set in.

4.2 Irrigation Subsidies

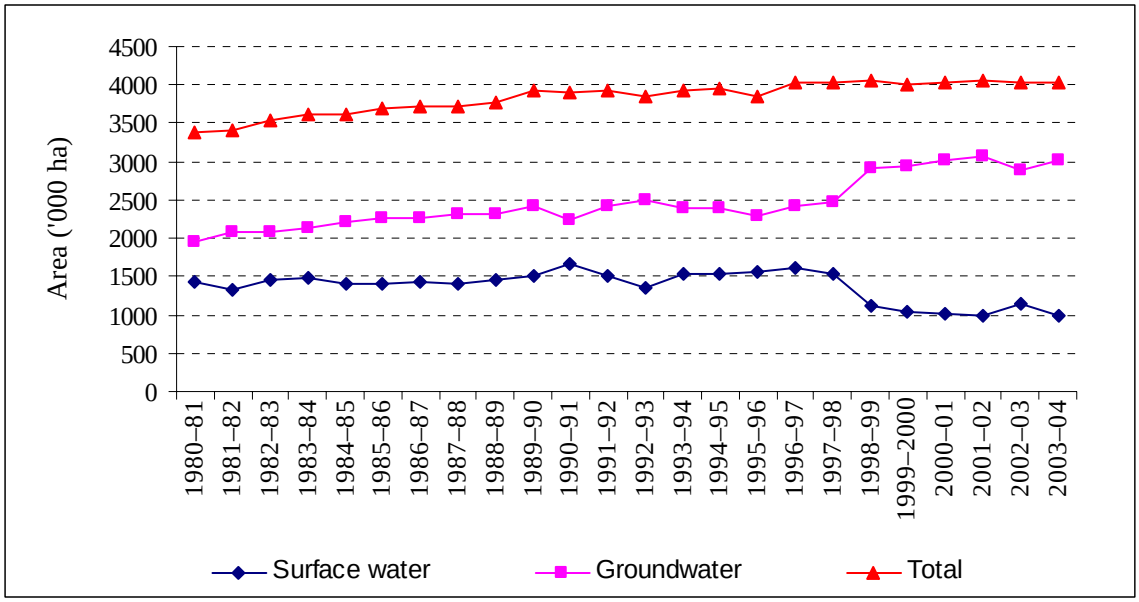
The ultimate irrigation potential (UIP) in Punjab is about 6 million ha, which is almost equally divided between major and medium irrigation, and minor irrigation. Of the minor irrigation, groundwater accounts for almost the entire amount. In Punjab, the exploitation of total UIP is very high (105.5 percent)—88 percent for major and medium irrigation and 123 percent for minor irrigation. The high level of UIP and its

[4] Apart from variety, the timing of sowing is also very important to affect the level of yield. For example, the yield of late-sown wheat (sown after mid November) is lower than that sown before mid-November. Similarly, early-sown paddy (sown in May), which is the major contributor to the declining water table, gives lower yield than when sown in June–July.

utilization in Punjab has enabled its farmers to achieve a high level of cropping intensity (1.86).

After increasing steadily, net irrigated area in Punjab has remained almost unchanged since 1998–99. However, the composition of net irrigated area has changed substantially: since 1998–99, the area irrigated through groundwater has risen and the area irrigated through surface water has declined (see Figure 4.5). This situation has resulted from (a) over-exploitation of groundwater and (b) neglect of maintenance of surface water channels.

Figure 4.5: Net Area Irrigated by Surface Water and Groundwater in Punjab, 1980–81 to 2003–04



Source: Government of Punjab, *Statistical Abstract of Punjab*, various years.

4.2.1 Efficiency

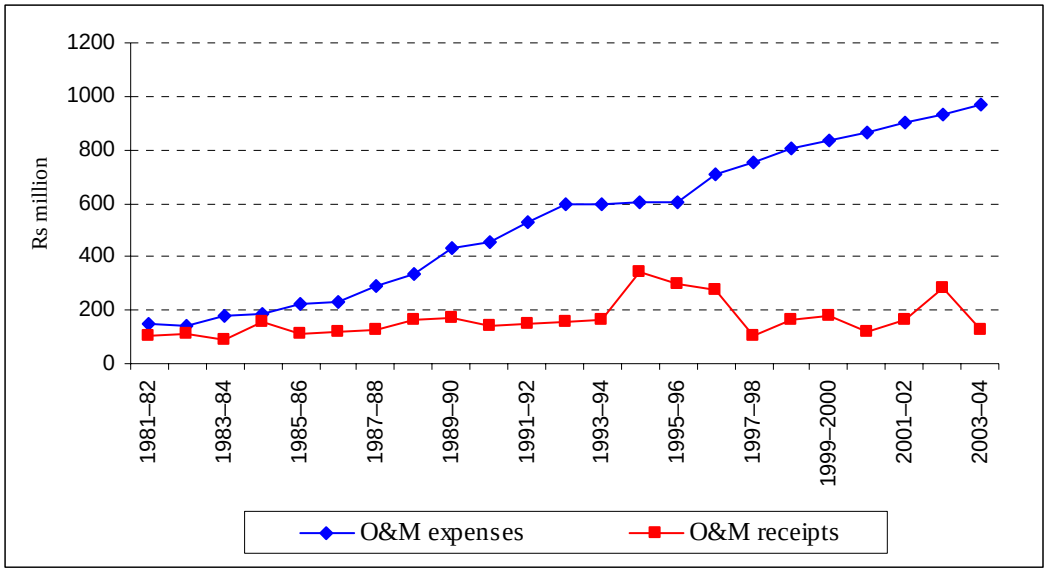
The efficiency of canal water use in India is very low as compared to that in the Western countries—for example, USA—which is close to 60–70 percent. A study of the Upper Ganga Canal estimated that 44 percent of water is lost at different stages of convergence, i.e. main canal, distributory, and watercourses. Farmers also tend to waste water, amounting to not less than 27 percent through flood irrigation. Thus, the actual water available for crops is only 29 percent of the total water supplied to the canal (Veeraiah and Madankumar 1994). The reasons for such high inefficiency of

canal water use are poor maintenance of distributaries and watercourses, unlined canal surface, and lack of awareness of proper application of water for irrigation. One factor strongly responsible for the inefficient use of water is low water charges, which creates disincentive for the economical use of canal water.

4.2.2 Financial Sustainability

The rising gap between the O&M expenses and receipts indicates the rising burden on the state exchequer of the cost of supplying irrigation service (see Figure 4.6). Receipts were as high as 71 percent of O&M expenses in 1981–82. The trend in falling ratio of receipts to O&M expenses started in the late 1980s (1987–88) and has continued with the exception of a marginal rise in 1994–95 and 1995–96. The situation has been worse since 1997–98. In 2003–04, the ratio of receipts to O&M expenses fell as low as 12.8 percent. Freezing of irrigation rates and the rising cost of collection of irrigation charges (including administrative cost) are cited as the main reasons for the extremely low ratio of receipts to O&M expenses. The average water rates were revised upwards slightly (from Rs 14.83 to Rs 98.84 per ha) in *rabi* in 1993–94 but were abolished by the Punjab government in February 1997 (Svendsen et al. 2005). As a result, O&M has been severely neglected.

Figure 4.6: Operation and Maintenance Expenses and Receipts from Major and Medium Irrigation Projects: Punjab, 1981–82 to 2003–04



Source: Government of Punjab, *Statistical Abstract of Punjab*, various issues; Kaur (2003).

4.3 Power Subsidies

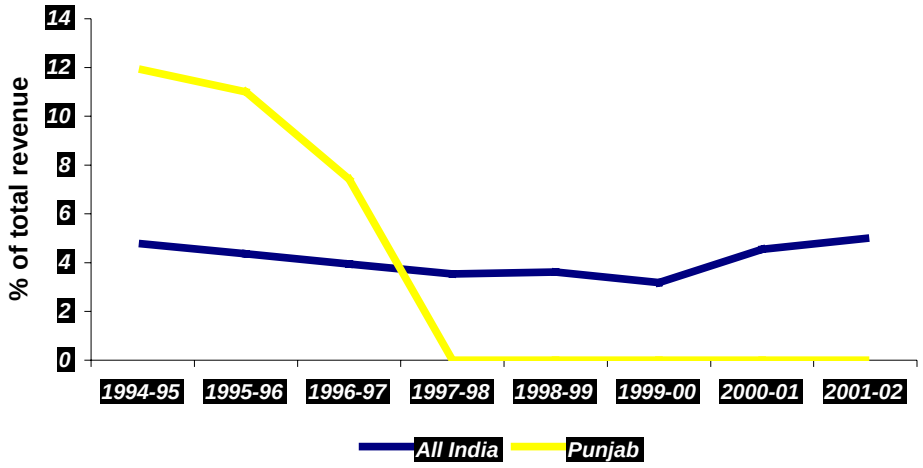
The importance of power in groundwater irrigation cannot be exaggerated. One of the consequences of the decline in canal-irrigated area in Punjab over time has been increasing dependence on groundwater for irrigation. The number of tubewells energized during the period 1982–83 to 2003–04 has increased phenomenally—from 0.31 million in TE 1982–83 to 0.86 million in TE 2003–04 (Appendix Tables A4.4a and A4.4b), making the electric pump the major means of irrigation.

As a result, consumption demand for power in agriculture has shown a sustained upward trend following the Green Revolution. While in 1950, the agricultural consumption of electricity as a percentage of total consumption was only 3.9 percent, by 1998 electricity consumption in agriculture reached a high of 32.3 percent of total consumption, agriculture being the largest consumer of electricity in that year. Punjab has reached its pump-set energization potential, with the number of pumpsets in the state exceeding the potential in 2000 (GOI 2002b). Despite this, electricity consumption has continued to increase, mainly on account of growth both in the number of pumpsets and in consumption per pumpset.

4.3.1 Growing Imbalances in Revenues, Costs, and Tariffs

In contrast to its highest share of electricity consumption, agriculture contributes the least to revenue. Figure 4.7 depicts the shares of revenue from agriculture for all-India and Punjab. In 1994–95, the shares of agriculture in total electricity consumption for all-India and Punjab were 32 percent and 47 percent, respectively, while the shares of revenue from agriculture were 4.8 percent and 11.9 percent, respectively. As a result of the reform process, the revenue from agriculture increased, but even by 2001–02, revenues from agriculture only contributed 4.6 percent of total revenue against a consumption share of 40 percent on a national basis. These figures are even starker for Punjab, since electricity to agriculture has been free of charge (Chowdhury and Torero 2007).

Figure 4.7: Share of Revenue from Agriculture in Punjab and All-India, 1994–95 to 2001–02



Source: GOI (2002g).

The major source of subsidy for agricultural (and domestic) power consumption has been cross-subsidy from industrial and commercial consumers. In fact, the tariff charged to industrial and commercial consumers in India has been one of the highest in the world—Indian tariffs are more than double those in China and nearly twice those in the OECD countries (Chowdhury and Torero 2007). This high-tariff for industry and high-subsidy for agriculture has had two opposing effects on these sectors: first, industry has opted to substitute self-generated power for power from the public grid; second, the perverse incentive scheme generated an electricity consumption boom in agriculture.

However, despite a high tariff for industry, the surplus generated in industry has always fallen short of the subsidy required in agriculture. In 1996–97, total cross-subsidy generated in all-India could cover only around 50 percent of the total subsidy needed for agriculture; in Punjab, this amount was just 29 percent. In addition to this shortfall, the gap between cross-subsidy generated and subsidy needed has been increasing as the rate of growth in cross-subsidy has lagged firmly behind the rate of growth in agricultural subsidy. As a result, in 2001–02, the total cross-subsidy was sufficient enough to cover only around 21 percent of the subsidy needed in agriculture on a national basis and just 14 percent in Punjab (GOI 2002b).

4.3.2 Decreasing Supply of Power

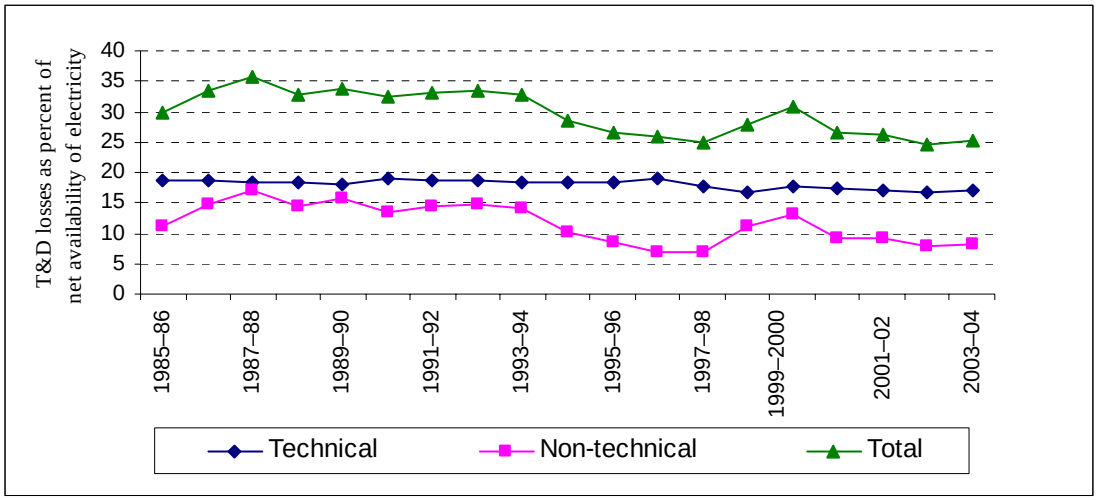
The supply of power to agriculture is highly unreliable, which adversely affects the life and efficiency of the electric pumps and entails additional expenditure on account of rewinding of burnt motors, purchase of higher horsepower motor, and investment in stand-by diesel sets. For instance, in Punjab, 16 percent of all cultivator households owned both electric and diesel pumpsets (Gulati and Narayanan 2003).

Not all potential users can be supplied power, however. In the year 2001–02, there were 380,994 pending applications for electric connections in Punjab, of which 317,062 (83.2 percent) were for agricultural use (Kaur 2003).

4.3.3 Increasing Theft of Power

Transmission and distribution (T&D) losses in TE 2003–04 were 26.7 percent of the net total availability of electricity in the state. Non-technical T&D loss (theft etc.) for agriculture alone was 48 percent of the electricity consumption of the agriculture sector. The revenue lost due to T&D losses is estimated to be of the order of Rs 17.873 billion in TE 2003–04 (see Figure 4.8).

Figure 4.8: Transmission and Distribution Losses in Punjab



Source: Government of Punjab, S*tatistical Abstract of Punjab*, various years; Punjab State Electricity Board website www.psebindia.org, accessed March 14, 2006.

4.3.4 Financial Sustainability: State Electricity Board in Dire Straits

A key result of these imbalances has been the rapidly deteriorating financial situation of the PSEB in Punjab. Expenditure has exceeded receipts consistently every year since 1991–92. The deficit (revenue expenditure minus revenue receipts) was almost one-third of the revenue receipts in 2000–01 (see Table 4.5). The absolute amount of deficit has increased since 1997–98, the period when electricity was given free of cost to the agriculture sector. In 1998–99, the cumulative deficit (Rs 37.07 billion) overtook the revenue receipts (Rs 35.66 billion) and thereafter the cumulative deficit has increased continuously. This situation obviously puts a big constraint on the capacity of PSEB to undertake fresh investment in the generation of power and/or improving the transmission lines to minimize transmission losses. The situation is made worse due to the state government not transferring cash to the PSEB to meet its deficit. Instead, the Punjab government adjusts the interest on loans given to PSEB against the deficit incurred by it. Thus, the PSEB does not get any resources for investment in return for the deficit it incurs on account of rising cross-subsidies.

Table 4.5: Financial Position of Punjab State Electricity Board

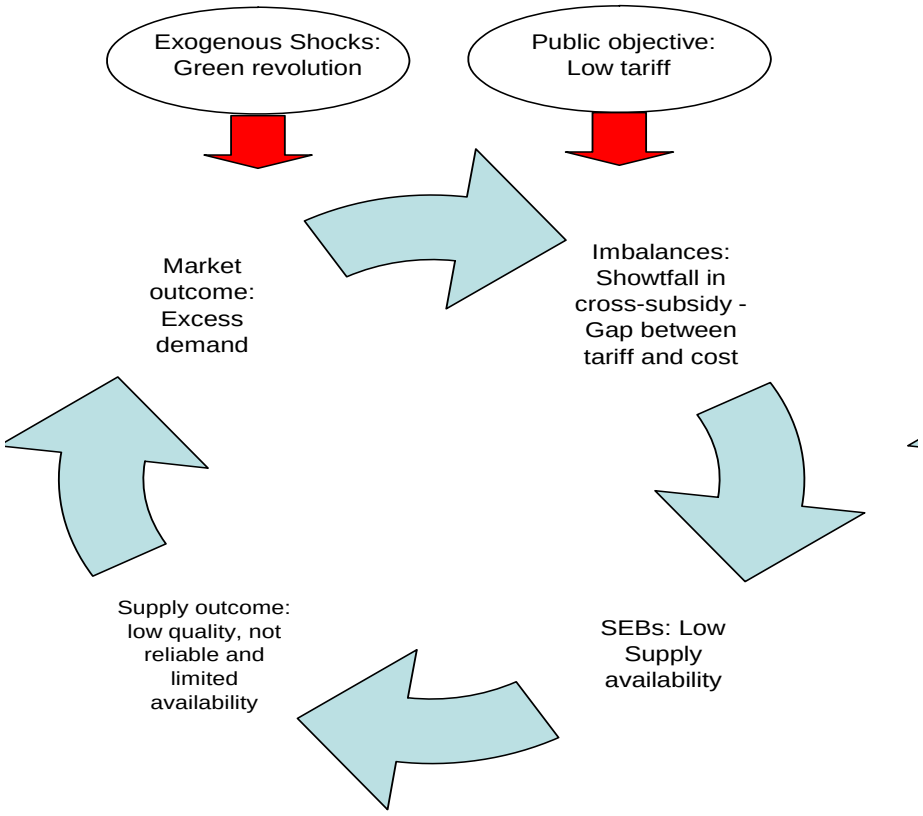
Year	Revenue receipts (Rs million)	Revenue expenditure (Rs million)	Deficit (Rs million)	Cumulative deficit (Rs million)	Deficit as percentage of revenue receipts (%)
1991–92	8,933.6	11,599.9	-2,666.3	-2,666.3	-29.85
1992–93	11,172.3	15,769.5	-4,597.2	-7,263.5	-41.15
1993–94	15,286.4	20,280.1	-4,993.7	-12,257.2	-32.67
1994–95	19,558.6	23,833.4	-4,274.8	-16,532	-21.86
1995–96	23,416.9	26,673.3	-3,256.4	-19,788.4	-13.91
1996–97	2,7514	30,473	-2,959	-22,747.4	-10.75
1997–98	30,902.8	36,455.5	-5,552.7	-28,300.1	-17.97
1998–99	35,663.2	44,432.9	-8,769.7	-37,069.8	-24.59
1999–2000	39,232.3	51,373.1	-12,140.8	-49,210.6	-30.95
2000–01	45,993.1	60,929	-14,935.9	-64,146.5	-32.47

Source: Punjab State Electricity Board website www.psebindia.org, accessed March 14, 2006.

4.3.5 Vicious Cycle of Power Supply in Agriculture

An ever-increasing demand for power in agriculture coupled with a declining tariff–cost ratio has resulted in a burgeoning power subsidy and mounting losses that the SEBs can no longer sustain. SEBs in India have entered into a vicious cycle where they cannot ensure quality, availability, and reliability in power supply due to low tariffs from farmers and farmers are not willing to pay a high tariff unless SEBs improve their supply. Given this trap, there are negative externalities that go beyond agriculture and power supply in agriculture: reduction of competitiveness in the non-agricultural sector due to high tariffs needed for cross-subsidizing agriculture, crowding out of public investment necessary for other social sectors and public infrastructures, to mention a few (World Bank 2003a). Figure 4.9 illustrates this vicious cycle of the power supply in agriculture.

Figure 4.9: Vicious Cycle of Power Supply in Agriculture



Source: World Bank (2003a).

Though tariffs are low for every farmer, it is the small and marginal farmers who disproportionately share the burden of a low-quality and unreliable power supply since they spend a greater share of their income to power irrigation pumps than large farmers. Since small and marginal farmers cannot afford alternative sources such as diesel pumps, their production is subject to higher production uncertainty than the larger farmers. Therefore, the costs per unit that are incurred for irrigation are usually higher than for large farmers. Studies in India have shown that farmers are willing to pay a higher tariff for a better supply of power (World Bank 2003b).

4.4 Distribution of Input Subsidies: Regional and Interpersonal Equity

The skewed distribution of land in Punjab is largely responsible for the unequal distribution of input subsidies**.** Contrary to the proclaimed intentions, the subsidies tend to: (i) increase regional income disparities (more subsidies to the Central Zone, which uses more electricity and fertilizer), and (ii) increase income disparities between farmers (more subsidies to medium and large holders).

4.4.1 By Zone

The Central Zone, which is a heavy user of power for tubewells and fertilizer, receives almost 60 percent of the total input subsidy bill, while the North East zone accounts for only 14 percent (see Table 4.6). Fertilizer (52.5 percent, Rs 2,836 per ha) and power (62.4 percent; Rs 5,356 per ha) subsidies (the two largest categories) go disproportionately to the Central Zone because it has large wheat and rice acreages and high tubewell density; irrigation subsidies go disproportionately to the South West zone because canal irrigation is concentrated there. As a result, the Central Zone receives a higher share of input subsidies in relation to its share of the state's net sown area. By contrast, less productive areas (e.g. the northeast and southwest) are allocated relatively lower levels of input subsidies compared to the Central Zone. Thus, input subsidies tend to accentuate regional disparities.

Table 4.6: Total Input Subsidies in Punjab by Zone, TE 2003–04

Zone	Net sown area (%)	Total input subsidy (Rs million)	Total input subsidy share (%)	Total input subsidy per ha of operated area (Rs)
North East	17.19	3,753	13.95	5,575
Central	46.78	15,580	57.90	8,327
South West	36.03	7,574	28.15	5,293
Total	100.00	26,907	100.00	6,769

Source: Vashishtha and Gupta (2006).

4.4.2 By Size-holding

Input subsidies are skewed towards medium and large farmers. Nearly 74 percent of the total input subsidy bill in 2000–01 went to medium and large farmers (medium and large farms accounted for 70.2 percent of operated area), while just over 5 percent accrued to marginal and small farmers (marginal and small farms accounted for 8.0 percent of operated area) (see Table 4.7). Marginal and small farmers receive roughly two-thirds the level per ha of cropped area received by medium and large farmers. On a component basis, the most heavily biased type of input subsidy is that on irrigation, with 77 percent going to large and medium farmers, compared to 4.5 percent received by marginal and small farmers. Per ha irrigation subsidy on large and medium farms being almost two times higher than that observed on small and marginal farms is also an indication, in the Punjab scenario, that the marginal and small farms suffer from being located in areas disadvantaged in terms of canal irrigation. Thus, in order to compensate for this disadvantage, the marginal and small farms may have to depend more on groundwater, for which power and/or diesel is required. This may affect their profitability adversely *vis-à-vis* large farmers. Seventy four percent of fertilizer subsidies and 73 percent of power subsidies go to large and medium farmers compared to 5.82 and 5.38 percent, respectively, to marginal and small farmers. The small relative proportion of power subsidy to marginal and small farms is perhaps because they are less intensively irrigated by using groundwater than medium and large farms. Thus, subsidies accentuate income disparities.

Table 4.7: Input Subsidies in Punjab by Size Groups, TE 2003–04

Input subsidy	Marginal and small (<2 ha)	Semi-medium (2–4 ha)	Medium and large (>4 ha)	All groups
		*Fertilizer**		
Amount (Rs million)	588	1,967	7,552	10,107
Per holding (Rs)	2,197	5,984	20,670	10,510
Per ha of cropped area (Rs)	1,913	2,207	2,720	2,542
Share (%)	5.82	19.47	74.72	100
		*Irrigation***		
Amount (Rs million)	33	138	574	745
Per holding (Rs)	125	418	1,572	775
Per ha of cropped area (Rs)	109	154	207	187
Share (%)	4.48	18.46	77.06	100
		Power		
Amount (Rs million)	826	3,510	11,719	16,055
Per holding (Rs)	3,087	10,677	32,079	16,696
Per ha of cropped area (Rs)	2,688	3,937	4,221	4,039
Share (%)	5.14	21.86	72.99	100
		Total		
Amount (Rs million)	1,447	5,615	19,845	26,907
Per holding (Rs)	5,409	17,079	54,321	27,981
Per ha of cropped area (Rs)	4,709	6,299	7,147	6,769
Share (%)	5.38	20.87	73.75	100

Note: * Farmers' share in fertilizer subsidy is obtained through import parity prices (IMPP) approach. Fertilizer consumption by size group for TE 2003–04 is projected on the assumption that the ratio of fertilizer consumption per ha of different size groups in TE 2003–04 remains the same as observed in 1995–96.

** Subsidy for canal irrigation is O&M charges minus receipts.

Source: Vashishtha and Gupta (2006).

4.5 Distribution of Input Subsidies: Crops [5]

The share of paddy and wheat together in the total input subsidy bill is over 86 percent, with paddy accounting for almost two-thirds of this share (see Table 4.8). Total input subsidies per ha on paddy were Rs 5,902 in TE 2003–04, as compared to Rs 2,391 on wheat. Power subsidies are the main component of total per ha input subsidies and, particularly for early-sown paddy, are largely responsible for the depletion of groundwater resources.

Table 4.8: Input Subsidies in Punjab by Crop, TE 2003–04

(in Rs million)

Crops	Fertilizer	Power	Irrigation	Total
Paddy	3,435	11,336	246	15,017
Paddy HYV	3,398	11,093	239	14,729
Paddy basmati	38	243	7	288
Wheat	5,201	2,636	326	8,163
Cotton	374	118	49	541
Cotton American	340	91	41	473
Cotton Desi	34	27	8	68
Sugar cane	186	436	13	635
Maize	115	49	10	173
Other crops	796	1,481	101	2,378
Gross cropped area	10,107	16,055	745	26,907

Source: Vashishtha and Gupta (2006).

Input subsidies for rice are over 15 percent of average net profits. The World Bank (2003c) carried out simulations of the impact of the removal of subsidies. The impact of the removal of the power subsidy is most pronounced on the profitability of rice, with profitability of other crops improving relative to rice. Removing the fertilizer subsidy further affects rice profitability. Together, these adjustments make alternative crops much more competitive. [6] The World Bank report did not include any HVCs in its calculations.

[5] In 2003–04(P), wheat accounted for 43.57 percent, rice for 33.07 percent, cotton for 4.88 percent, maize for 1.95 percent, and sugar cane for 1.56 percent of gross cropped area.

[6] Note that subsidies are just part of the policy picture that favors wheat and rice. Guaranteeing high levels of prices through the MSP is a further incentive. Perhaps the greatest incentive is the stability of guaranteed prices. Together, high subsidies and guaranteed high commodity prices pose powerful incentives to perpetuate the present wheat–rice system.

4.6 Environmental Sustainability

High nitrogen use has resulted in run-off of the excess fertilizer. Micronutrients are being mined and not replaced, resulting in widespread micronutrient deficiencies.

Waterlogging and increase in salinity in several parts of Punjab have been caused by excessive seepage from canals and excessive irrigation from groundwater (through tubewells). Since the electricity rate charged for the use of electric pumps / tubewells is very low, tubewell owners also tend to waste water through over-irrigation. About 122,000 ha of area in Punjab is either waterlogged or experiencing rising water table. Another 393,000 ha is salt affected in the canal command area. In addition, 127,000 ha is salt affected outside the canal command area (Bajwa 2002). Thus, 624,000 ha of irrigated land (both canal and tubewell irrigated), i.e. almost 16 percent of the net irrigated area, is degraded due to seepage from canal and/or excessive irrigation, including from groundwater (see Appendix Table A4.3).

Although the Punjab government increased capital expenditure on irrigation schemes in the Ninth Plan, the neglect of investment in this sector in the past has led to deterioration of the maintenance of canal system. This led to a decline of 32 percent in canal-irrigated area over the decade TE 1992–93 to TE 2003–04, with the largest decline being observed in the North East Zone (58.8 percent). In the Central Zone, the decline in the net irrigated area by canal was of the order of 21 percent. The decline in canal-irrigated area was triggered by a combination of low discharge of water in canals and the low charges (even zero for some years) for use of canal water leading to poor O&M.

A direct consequence of the simultaneous decline in net irrigated area and increase in tubewell density has been the acceleration in the fall in the water table, especially in the Central Zone. If the present trend continues, the number of blocks in Punjab falling in the critical level of water table (10 meters and above) is likely to increase from 35 (of 141 total blocks) in the year 2000 to reach an alarming figure of 72 (i.e. nearly half of 141) in 2030 (see Appendix Table A4.5).

4.7 Public Expenditures and Investment

The Government of Punjab funded subsidies on power and water[7] cost the state government 6.8 percent of the agriculture state domestic product (SDP) in 2001–02.

[7] Fertilizer subsidies are borne by the Central government.

Subsidies on fertilizer funded by the Central government increase the total figure to over 10 percent.

For TE 2000–01, capital and current expenditures in Punjab accounted for, on average, 4.7 percent of agricultural SDP, a lower percentage compared to other agriculturally important states and less than all states except West Bengal (World Bank 2003c). Public capital expenditures—primarily investments in irrigation and flood control—were only 1.9 percent of agriculture SDP, viz. less than the 2.2 percent average across all states in the country. However, public current expenditures—which are of even greater impact because they include such development needs as research and extension and O&M in irrigation—in Punjab are among the lowest among main agricultural states. For TE 2000–01, they were only 2.7 percent of agricultural SDP in Punjab, less than half the all-India figure of 5.6 percent (see Table 4.9). Without adequate resources to meet these vital needs, lives of existing assets get shortened and technology generation and adoption, essential for improving productivity, is compromised.

Table 4.9: Public Expenditures in Agriculture across Main States in India, Average for 1998–99 to 2000–01

	Agriculture expenditure (Rs billion)	Percent of agricultural expenditure to agriculture SDP	Composition of agriculture expenditure	
			Share of capital expenditure in agriculture SDP (%)	Share of current expenditure in agriculture SDP (%)
Andhra Pradesh	30.5	8.1	2.7	5.4
Bihar	13.9	5.9	2.1	3.7
Haryana	9.6	6.0	1.9	4.1
Karnataka	29.0	10.5	4.1	6.4
Madhya Pradesh	21.9	7.7	1.8	5.9
Orissa	12.8	9.8	4.5	5.3
Punjab	11.5	4.7	1.9	2.7
Rajasthan	17.9	7.8	2.5	5.3
Tamil Nadu	24.2	11.0	1.9	9.1
Uttar Pradesh	33.6	5.3	1.0	4.2
West Bengal	16.0	4.1	0.6	3.5
All states	357.4	7.8	2.2	5.6

Source: Estimated using data from Reserve Bank of India (2001, 2002a); Government of India, *National Accounts Statistics*, various years; World Bank (2003c).

Private capital formation, which is the dominant source of investment in the sector (four to six times of public capital formation), decreased in real terms in the first half of the 1990s, but has stabilized since then.

Empirical evidence has demonstrated that initial subsidies in credit, fertilizer, and irrigation motivated farmers, especially the small farmers, to adopt new technologies and improved practices in India (Fan and Gulati 2004). However, now the positive production influence has lessened significantly. The subsidies generate huge costs to public resources that could otherwise be employed to much higher productivity usage. Agricultural research, roads, and education rank as the top three public investments in terms of their economic returns—whether evaluated against increasing agricultural productivity or decreasing poverty—much higher than input subsidies (Fan et al. 1999; Fan and Gulati 2004).

4.8 Concluding Remarks

It is clear that subsidies have contributed to increased wheat and rice production in Punjab. However, the costs of these subsidies have now begun to overtake, if not already overtaken, their benefits.

There is a clear presumption that cereal yields have reached stagnation. Agronomists opine that the stagnating yields are closely associated with the declining grain–fertilizer response ratio, which is attributed to a combination of the following factors:

- Nitrogen is particularly over-applied, resulting in a highly distorted N/P ratio. This not only lowers the grain–fertilizer response ratio but also results in a considerable waste of nitrogen (N), which, ultimately, leads to groundwater pollution.
- The soils have become deficient also in micronutrients due to intensive cultivation for prolonged periods. The continuous cycle of rice–wheat rotation is taxing to the soil in terms of extraction of micronutrients from the soil without compensatory application of nutrients.
- The potential of the new seed varieties has been exhausted. Additional doses of fertilizer do not bring significant extra output.

For both major cereal crops (rice and wheat), Punjab seems to be reaching a situation where decline in fertilizer response ratio, stagnation in yield level, and declining soil fertility has already set in.

Unfortunately, the irrigation sector today in Punjab is characterized by several disquieting features: falling public investment, low canal water use efficiency (25–40

percent as compared to the achievable level of 65 percent), poor maintenance of distributaries and watercourses due to low recovery from beneficiaries, which is only a small proportion of expenditure on O&M (20–25 percent), and poor governance of the entire irrigation system. The use of electricity in agriculture has already shown signs of diminishing marginal return starting from the 1980s.

Many of these imbalances stem from the inbuilt inefficiency in the current pricing mechanism and measuring system of power for irrigation. At the margin, farmers incur almost zero cost for irrigation in the short run (ignoring depreciation cost due to additional use and marginal labor cost of additional use). Farmers, therefore, have a pervasive incentive to overuse electricity and water,[8] and in Punjab, this has led to a rapid depletion of the groundwater table. Linked to the pricing mechanism is the measurement problem that breeds inefficiency and corruption. At present, there is no accurate estimate of actual power consumption in agriculture. The provision of electricity and irrigation at concessional rates has encouraged the inefficient use of a scarce resource such as water, distorted intertemporal resource allocation, and promoted spatial, interpersonal and intertemporal inequalities. The over-exploitation of groundwater has caused a fall in the water table in large parts of the state, which has entailed increased expenditure on deepening of tubewells.

In summary, input subsidies are perpetuating a high-input farming system—mainly of wheat and rice—which:

(i) because of declining demands and high levels of inputs, declining input responses, and declining yield increases, is decelerating and nearing stagnation, albeit at high-income levels, in the near term; and

(ii) because of environmental abuses, is promising to reverse direction, with declining income levels, in the longer term.

[8] For instance, Gulati (1999) mentions that farmers in India use irrigation water for controlling weed growth—an example of input substitution created by skewed incentives.

Appendix Table A4.1: Average Economic Subsidies on Fertilizers

(Rs per ton)

Year	Urea (N) (46% nitrogen)			Diammonium Phosphate (P) (DAP, 18-46-0)			Muriate of Potash (K) (K_2O, 60%)		
	IMPP	Domestic price	Subsidy to farmers	IMPP	Domestic price	Subsidy to farmers	IMPP	Domestic price	Subsidy to farmers
1981–82	2,655	2,350	305	3,176.5	3,600	-423.5	2,193.5	1,300	893.5
1990–91	4,334.9	2,350	1,984.9	4,995.5	3,600	1,395.5	3,017.2	1,300	1,717.2
1991–92	4,834	3,060	1,774	5,307.5	5,040	267.5	3,645.5	1,700	1,945.5
1992–93	5,006.4	2,760	2,246.4	5,679.6	6,650	-970.5	4,473.7	4,500	-26.3
1993–94	4,931.4	2,760	2,171.4	5,459.8	6,600	-1140.2	4,408.9	3,800	608.9
1994–95	7,256.8	3,320	3,936.8	7,833.2	7,753	80.0	4,601.8	3,786	815.3
1995–96	8,219.6	3,320	4,899.6	9,068.5	9,693	-625.2	5,225.2	4,290.5	934.7
1996–97	7,878.2	3,490	4,388.2	8,503.8	8,394	109.8	5,532.2	4,122	1,410.2
1997–98	6,336.7	3,660	2,676.7	10,146.2	8,300	1,846.2	6,560.6	3,700	2,860.6
1998–99	5,694.1	3,660	2,034.1	11,445.8	8,300	3,145.8	7,345.2	3,700	3,645.2
1999–2000	5,097.7	4,000	1,097.7	10,630.3	8,300	2,330.3	7,741.5	3,700	4,041.5
2000–01	6,869	4,600	2,269	10,027.8	8,900	1,127.8	8,140.2	4,255	3,885.2
2001–02	7,259.6	4,830	2,429.6	10,395.3	8,900	1,495.3	8,065.6	4,255	3,810.6
2002–03	9,279.5	4,830	4,449.5	11,732.6	9,350	2,382.6	8,205	4,455	3,750
2003–04	-	-	4,721.0	-	-	2,528.0	-	-	3,978

Note: IMPP (Import Parity Prices) = c.i.f. price (on ship) + pool handling expenses + dealers margin;
DAP: Diammonium Phosphate; K_2O: Potassium Oxide.
Source: Gulati and Narayanan (2003); GOI (2004).

Appendix Table A4.2: Total Fertilizer Subsidy and Farmers' Share in Total Fertilizer Subsidy in India

Year (TE)	Total fertilizer subsidy (Rs billion)	Farmers' share in total subsidy on fertilizer (Rs billion)	Farmers' share in total subsidy on fertilizer (%)
1992–93	51.23	38.74	75.6
1995–96	56.89	72.72	127.8
1998–99	96.97	87.03	89.8
1999–2000	115.86	75.32	65.0
2000–01	128.80	77.51	60.2
2001–02	132.13	70.37	53.3
2002–03	124.7	70.68	56.7

Source: GOI, *Economic Survey*, various years; Vashishtha and Gupta (2006).

Appendix Table A4.3: Area of Degraded Land by Nature of Degradation in Punjab

Wasteland/Soil degradation	Area (million ha)
1. Water erosion	
i. Severe (gullies, ravenous)	0.17
ii. Slight and moderate (with/without scrubs)	0.34
2. Water-logged—rising water table	0.122
3. Marshy—submerged	0.228
4. Salt-affected (Varying degree of deterioration)	0.393
i. Canal Command Area	0.127
ii. Outside canal Command Area	
5. Degraded forest/pasture land	0.20
6. Coarse/very light texture (loss of nutrient with deep percolation and leaching, poor in fertility)	0.62

Source: Director, Punjab Remote Sensing Centre, Ludhiana as quoted in table 4 of Bajwa (2002).

Appendix Table A4.4: Number and Percentage Increase of Tubewells Energized by Zones: Punjab

(a) Number of tubewells energized

Zone	TE 1982–83	TE 1992–93	TE 2003–04
North-east	65,657.1	121,342.9	148,304.7
Central	193,118.6	380,398.5	512,427.3
South-west	49,220.6	127,849.9	195,236.3
Punjab	307,996.3	629,591.3	855,968.3

(b) Percentage increase of tubewells energized over the previous decade

Zone	TE 1992–93	TE 2003–04
North-east	84.8	22.2
Central	97.0	34.7
South-west	159.7	52.7
Punjab	104.4	36.0

Source: Government of Punjab, *Statistical Abstract of Punjab*, various years.

Appendix Table A4.5: Expected Decline of Water Table Beyond Critical Level of 10 Meters

Depth of water table (meters)	Number of development blocks in Punjab			
	Year			
	2000	2010	2020	2030
10–12	22	19	16	19
12.51–15	8	20	16	7
15.01–17.5	4	10	14	18
17.51–20	1	2	7	9
20.01–22.5	-	4	2	8
22.51–25	-	-	4	5
25.01–27.5	-	-	2	3
27.51–30	-	-	1	1
>30	-	-	-	2
Total number of blocks	35	55	62	72

Source: As quoted in Bajwa (2002).

Chapter 5
Conclusions and Recommendations

Punjab agriculture is clearly at a crossroad. Agriculture is dominated by wheat and rice, which now cover over three-quarters of cropped area and account for 85 percent of the gross value of crop output. All incentives are stacked in favor of wheat and rice. However, rice yield has almost stagnated (increasing by only 0.02 percent annually during the 1990s) and wheat yield has slowed down significantly (with annual gain declining from 2.96 percent in the 1980s to 1.96 percent in the 1990s). Sustained economic growth, increasing urbanization, expanding trade liberalization and globalization, and changing lifestyle patterns are shifting consumption patterns in the economy away from wheat and rice, toward high-value agricultural commodities. The state has been experiencing increasing stress on natural resources. Fertilizer, especially nitrogen, is being used at levels exceeding the recommended amounts, contributing to imbalances among nutrients (too much N relative to P and K), and micronutrient deficiencies have become serious (for example, zinc content is only 48 percent of the required level), resulting in low marginal returns to fertilizer (2 kg of grain to one kg of fertilizer). Largely due to (especially early sown) paddy cultivation, groundwater levels have been falling, especially in the Central Zone at a rate of almost one-quarter meter per year. Large areas are being lost to salinity and waterlogging, especially in the south-western cotton zone. Thus, the sustainability of agriculture is under threat.

The situation, however, is not yet at a crisis. Among Indian states, Punjab has the highest yields and lowest costs for rice and the highest yields and among the lowest costs for wheat. As a result, farmers' incomes in Punjab are higher than in other states.[1] However, incomes have been stagnating in the near-term. The crop sector grew by only 1.3 percent per annum in the 1990s, down from 4.8 percent in the 1980s, and has had negative growth in the early 2000s. In the longer term, changing demand,

[1] Punjab has clear advantages for agriculture. The state has ample sunlight, relatively low humidity, and moderate temperatures. It has very high density of tractors (106 per thousand ha compared to 22 per thousand ha for all all-India level) and irrigation (90 percent of cropped area compared to 40 percent at all-India level) and high fertilizer use (210.06 kg per ha, which is double the all-India usage of 104.5 kg per ha) with a cropping intensity of 186 percent (compared to all-India average of 135). It has good infrastructure—roads (with density 1.27, which is one and a half times the all-India density of 0.81), markets (during harvest, farmers can typically find a purchase center for foodgrains within 8–10 km of their village, by far the best market density in the country), and communications [especially cell phones (with number of subscribers at 200 million in February 2007) and computers]. Furthermore the state has a number of very talented and industrious farmers.

away from wheat and rice, and deteriorating environment will lead to progressively decreasing incomes.

Thus, Punjab agriculture has reached a point where it must make significant changes if the state is to move forward. Conversely, if it does not rationalize incentives, reinvigorate old institutions and create new institutions, and increase investments significantly, it will suffer declining income and employment and irreversible environmental degradation.

Diversification toward high-value commodities—basmati and fine long-grained rice, durum wheat, fruits and vegetables, milk, poultry, fish and their processing—has already begun in Punjab. This high-value segment contributes over 40 percent (TE 2002–03) of the total value of agricultural output. Dairy, the largest component, is particularly important for smallholders, accounting for 54.6 percent of farm business income on marginal (less than one ha) farms and 37.4 percent on small (1–2 ha) farms during 2002–03 as well as for women, who account for over 90 percent of the labor force working with farm animals, including dairy. While Punjab is one of the most productive states from the standpoint of yields compared to the rest of India (yields of onions and peas are nearly double the all-India average while the productivity of potatoes, cauliflower, mangoes, chilies, guavas, grapes, and tomatoes are all well above the all-India norms), it is a relatively minor producer of fruits and vegetables (2.2 percent of the all-India total). Per ha net returns for high-value commodities are generally much higher—onions fivefold, green peas two and a half times, and potatoes double—than for wheat and rice.

Punjab has seen the emergence of innovative private sector initiatives in the form of business-oriented cooperatives and contract farming. The state is on the threshold of a boom in retail marketing, with big supermarkets about to emerge. The Punjab government has been trying to aggressively promote diversification and attract agri-business for processing, retailing, and exporting. Other countries in Southeast Asia have followed this course of diversification with considerable success. This gives rise to the question of why Punjab is not moving faster in its transition to diversification.

We would suggest that the changing scenario demands a different role for government in the future than it has exercised in the past. Food security is much more than foodgrains self-sufficiency or availability alone.[2] And achieving food security is much more than the Punjab government's responsibility alone. Economic forces, led by

[2] Availability no doubt is the key, and as long as India has adequate foreign exchange reserves, based on comparative advantage, it is perfectly alright to import foodgrains or any other food. There are many food items other than foodgrains in a well-balanced diet.

market demand—domestically and globally—if allowed to operate, will drive the road to diversification, under the leadership of the private sector. Increased incentives can contribute to 'getting prices right'. Strengthened institutions can change the rules of the game in addition to the organizations in which they are embedded—for example, prices will never truly be effective allocators of resources if markets are not effective, so the challenge is also to 'get markets right'. Increased investment can provide the physical infrastructure and technologies necessary for creating and moving inputs, services, and commodities.

In the changing environment, it is equally important to specify what the government should not do as well as what it should do. It is equally important to present policies as a package in order to provide trade-offs to gain the necessary political support. Political forces will influence whether, and what parts of, the recommendations are adopted. Some individuals will benefit more and some will benefit less or even lose on individual parts. Often, many individuals benefit a little, a few lose a lot; and these few organize themselves and thwart the many. If done correctly, a package of investments and policies can provide trade-offs in which all individuals have net benefit. The role of the government, therefore, should be to provide (i) public goods—particularly infrastructure and research, and (ii) policies to facilitate, guide, and monitor an inclusive process so that the pace of diversification accelerates and the benefits are distributed widely. The package should embrace changes in marketing and foodgrains management and input subsidies and promote diversification. The components of the required package are outlined below.

The government should also relieve certain constraints to diversification, primarily the current, outdated system of public foodgrains management that favors wheat and rice and crowds out private marketing and the pervasive subsidies that give significant incentives to foodgrains—with both the public foodgrains management system and subsidies diverting scarce public resources from more productive investments that could facilitate diversification.

5.1 Promote Diversification

The government can take certain steps to promote diversification. Key to future success are:

- Promoting value-added processing, for example to convert grains such as wheat and dairy (mainly milk and butter) into bakery items, citrus such as kinnows and oranges into juice, and maize into fuel.

- Investing in and providing incentives to the private sector to modernize infrastructure and institutions to handle the special marketing and processing needs of high-value commodities (for example, cold storage, sanitary and phytosanitary measures (SPS), etc.).
- Developing better yielding, better tasting, more disease-resistant varieties of HVC along the lines of what was done for wheat and rice.

Changes are necessary to:

(i) Improve the links between farmers, processors, and retailers:

A critical first step for promoting agricultural diversification is continued reform of the APMC Act, in three areas mainly. First, contract farming relationships need to be strengthened as per the conditions spelled out in the Model APMC Act. The Model APMC Act requires the strengthening of contract farming relations in a manner that protects both the interests of the farmer and the buyer. In particular, the Model Act strengthens the contract terms to protect the interests of both the buyer and seller by more clearly spelling out each party's obligations under the contract. Unlike the PAFC contract, farmers are not allowed to renege on the contract if prices rise above the contracted price. Moreover, the Model Act contract addresses issues of insurance, in case of crop failures, and formal remedies for arbitration at a state government level, should any breach of contract be recorded. However, such reforms remain stalled in Punjab. Indeed, the approach taken by the Punjab government to promote diversification through contract farming may work against such types of arrangements, given the looseness of PAFC-mediated contracts and bias towards farmers over buyers. Clear-cut (formal or otherwise) rules are required for contract relationships to evolve over time.

Second, while private sales yards have been allowed, it is not clear from the legislation whether direct sales between farmers and processors at the processor's gate (for example) are permissible or the ease with which licenses can be procured to establish private sales yards. Though more research on this is required, it remains clear that the creation of transparent mechanisms to facilitate private sales yards is a crucial step to enable the unimpeded access of agribusiness to farmers, markets, and infrastructure to improve the volume and quality of transactions among high-value products.

Third, reforms of the APMC need to remove the bias of contract farming away from diversification, given that it may not always be the ideal vehicle to links farmers with markets. At present, the Punjab government has attempted to promote agricultural

diversification by exempting market fees for those engaged in contract farming in fruits and vegetables. Market fees are also exempted for private entities that purchase wheat or rice for processing purposes, while fruit and vegetable processors who are not involved with contract farming receive a four-year exemption from market fees. These fee reductions are important from the standpoint of cost savings by buyers, given the structure of market fees currently in place (see Appendix Table A5.1). In essence, taxes for buyers would fall from their current 11.5 percent, the highest in India, to 4 percent, since private sales via contract farming would also avoid commission charges by agents in *mandi* yards.

While these reductions on market fees are important for Punjab agriculture to remain competitive with agriculture in other states and in overseas markets, they should be applicable to all elements of agribusiness activities in addition to contract farming. However, such a proposal would have a fiscal cost, as exempting high-value produce from the market fees currently imposed in *mandi* yards would reduce the amount of state revenue available for rural development and infrastructure activities, for example. It would potentially have some political implications as well, particularly from commission agents who would stand to lose from a greater proliferation of private sales yards that bypassed *mandis*. However, lowering tax levels may not necessarily reduce tax revenues by the amount feared, given that by increasing the number of participants and demand in the sector it could induce higher growth than without such tax reductions.

(ii) Improve environment in which HVCs can operate:

Concomitant with national- and state-level reforms of agricultural price and subsidy policy and state-based reforms of the APMC are supporting measures that improve the environment in which HVCs can operate, including basic marketing infrastructure (roads and dedicated market yards), risk and mitigation strategies (insurance markets, storage infrastructure), and the development of markets, through direct means (e.g., trade promotion activities) and indirect policy reforms [e.g., allowing foreign direct investment (FDI) in food retail].

The existence of physical and marketing infrastructure, such as roads, cold storage, and packing facilities, would improve quality and add value to produce, increase farmer prices, and reduce losses in handling and transport. The *Economist* (2006: 11) reports that ‘it takes eight days, including 32 hours waiting at checkpoints and toll booths, for a lorry to crawl from Kolkata to Mumbai’, a distance of 2,150 km. The

public marketing system is characterized by congestion and poor sanitary conditions in *mandis* and lack of market transparency (World Bank 2003c). The condition of fruits and vegetables markets is especially poor. Support services such as grading, standardization, and information systems are not adequate and quality improvements have been lacking. The marketing system is such that the farmer has little incentive to improve the quality and cleanliness of the produce. Improved infrastructure would assist in reducing seasonal price variability and open new markets (domestic and export) to produce from Punjab. One positive factor is the rapid spread of cell phones across India, reportedly at a rate of six million per month (Singh 2007), with cell phones being used regularly by all traders and many farmers. Computers are also rapidly being adopted in markets throughout India, providing instant links on prices, quantities, qualities, etc.

The development of infrastructure and markets is not without costs. Indeed, current incentives to promote diversification in Punjab involve a reduction in marketing fees and charges that are explicitly aimed at funding public investment in agriculture. While it can be argued that much of this investment is targeted towards rice and wheat and the quality of such investment remains suspect, public revenues would be required to support investment in activities that promote diversification. As an example, the investments in infrastructure proposed by the National Horticulture Board would cost Rs 180 million; such a figure could easily be paid from the net surplus in revenue generated by a tax on rice production even after paying for lowering taxes on HVCs.

Risk mitigation strategies are an important component to promote high-value commodities. HVCs such as fruits and vegetables are typically more risky than grain crops both in terms of price risk and yield risk. An active crop insurance market, in which farmers paid private premiums to insure their crops against the vagaries of weather, disease, etc., would provide a type of safety net for farmers that is presently lacking.

(iii) Strengthen agricultural research on high-value commodities:

The power and value of agricultural research cannot be underestimated. Just as it was the key to the Green Revolution in wheat and rice, it also could be the key to transition to HVCs through fruits, vegetables, dairy, and poultry.

The proportion of agricultural sector domestic product in Punjab going to research is similar to that in other states, but low when compared to all developing countries (World Bank 2003c). The allocation of research funds within the Punjab Agricultural

University (PAU), which is the major research arm in Punjab and which made major contributions to wheat and rice technologies, has been slow to respond to new demands for a diversified agriculture. The share going to horticulture, livestock, and post-harvest has either stagnated or decreased slightly. Research on marketing, policy, integrated pest and nutrient management, and organic farming has been especially weak. Although water is a critical input, a comprehensive research strategy for addressing water management has been lacking. Research is operated through a large number of schemes, leading to resources being spread thinly.

The private sector could be a vital contributor to research. However, World Bank (2003c) notes that large private agribusiness investors in HVCs in Punjab have largely imported their technologies from elsewhere and have depended little on PAU technologies. Given the heavy dependence on imported technologies until the PAU gets reoriented, modernizing the quarantine practices becomes a priority for near-term, if not longer-term, success.

Extension is a continuing weakness. The World Bank (2003c) suggests redefining public–private roles in the extension services currently being provided and privatizing as appropriate. For example, it suggests that input-related services such as planting materials, fish fingerlings, and veterinary services should be privatized. With sophisticated farmers and a commercialized agriculture, there is little reason for the public sector to remain engaged in these activities, beyond regulatory oversight.

5.2 Reform Marketing and Public Foodgrains Management

Why is the current, outdated system of public foodgrains management a constraint to diversification? The government, through a Minimum Support Price (MSP), 'contracts' with farmers to purchase all the wheat and rice they produce at high, stable and assured prices to provide food for the Public Distribution System (PDS). The rationale for continuing this practice is highly questionable, as:

- Benefits have declined while costs have skyrocketed; [3]
- Development of private sector marketing, which is probably more effective and efficient, is inhibited;

[3] The cost of grain management has three main components: (i) quantity procured, (ii) price of procurement, and (iii) costs of operation. Of particular concern has been the fact that since the mid 1990s MSP has increased much faster than C_2, widening the profit for the Punjab farmer. During 1981–89, the average difference between MSP and C_2 was 20 percent for wheat and 14 percent for paddy and widened to 21 percent for wheat and 19 percent for paddy in 1990–95. The encouraging development is that the MSP has been almost frozen since then.

- Guaranteed high returns for wheat and rice and their assured procurement provide incentive against which HVCs, for which both production and price risks are high, have difficulty competing.

The key issue is to effectively decouple price support from procurement, that is, decouple MSP as protection against price risk from using it to augment income.[4] Under the present system, government requirements to supply the PDS and maintain a buffer stock necessitates a major role for the public sector at all stages of the supply chain. The existence of large Central and state-run procurement agencies operating with soft budget constraints and monopoly control over international trade undercuts the purchasing activities of the private sector at profitable prices. Likewise, non-transparent open market sales at retail depress private sector profits and discourage long-run planning. Combined with favorable access to credit and transportation facilities and regulations that restrict direct linkages with farmers and do not reward quality, public sector activities to control the distribution of large volumes of foodgrains impede the potential of the private sector.

Reducing the scope of public intervention in the grain sector would free, from inefficient grain-handling activities, scarce government resources that could be subsequently reallocated towards the development of infrastructure necessary to improve diversification activities and improve the health of the agriculture sector in the state. A liberalized foodgrains distribution sector would induce more private players into the industry in the retail side, who would develop ways to create backward linkages in other operations within the supply chain (procurement, storage, transportation, and logistics), provided government buffer stocks were set at low, transparent levels and open market sales were made in ways that were predictable and based on pre-established rules.

Accordingly, we suggest the following:[5]

---

[4] Two observations highlight the obvious need for this change:
(i) Total foodgrains stocks reached about 65 million tons in the summer of 2002. As of end March 2006, wheat stocks were 2.26 million tons.
(ii) During the summer of 2006, market prices exceeded the MSP (the procurement price), and the government had to import wheat for PDS and to replenish the buffer stock at international prices that exceeded the domestic market price.

[5] Our suggestions are consistent with several of the recommendations of the High-Level Committee on Long-Term Grain Policy (GOI 2002d). We agree that:

1. The private market system should be strengthened and should carry on most of the purchasing and distribution of agricultural commodities throughout the country.
2. Prices should be stabilized within bands, using a variable tariff policy.
3. Foodgrains for public distribution and buffer stock should be purchased in the open market.
4. The role of the FCI should be reduced and it should increase its activities in the eastern part of the country.

(i) Facilitate strengthening of private marketing through reforming the Agricultural Produce Marketing Committee (APMC) Act, abolishing the Essential Commodities Act (ECA), eliminating movement and storage controls, strengthening futures markets, and opening imports and exports to the private sector:

The operation of an active, competitive, private marketing system is essential to successful agricultural development in general and to accelerated transition to diversification, in particular. The key for greater private sector participation in grain management is policies that reduce uncertainty. At present, the public grain management system imposes significant amounts of risk on private sector participation by crowding out private activities and reducing the profitability of functions within the supply chain.

As a first step, full implementation of the Model APMC Act by the Punjab government is required. The Model APMC Act tabled by the Government of India aims to improve the environment in which agricultural produce can be marketed, allowing for private market yards, direct sales and procurement between farmers and the private sector, promotion of contract farming and public–private partnerships, and rationalization of market fees and licensing requirements. The Punjab government has made progress in adhering to a number of these components, including the redefinition of market yards to include private yards that have received a license from the state government and exemption of market fees for private entities that purchase wheat or rice for processing purposes. However, strengthening of contract farming legislation remains stalled, while the ease of establishing private marketing yards is not known.

Similar reforms that make permanent the reforms of the ECA, including abolishing restrictions on private movement and storage, would also enhance stability in the grain sector for private sector actors.

Public operations, such as open-market sales, should be more predictable and transparent, so that the private sector can take these actions into account in planning its own operations.

Differing from the recommendations of the High-Level Committee, we think that:

1. Public distribution should be targeted in order to protect the poor and vulnerable but not subsidize middle- and high-income consumers, to reduce budget demands, and (by reducing public domination of the market) to permit the private trade to operate more effectively.
2. The MSP should be set at A_2 costs to cover cash costs of production rather than at C_2 costs to cover full (including imputed) costs of production, that is, the MSP should mitigate against risks rather than augment income.

The rationale for government monopoly of either foodgrains imports or exports is clearly no longer valid. The experience of Bangladesh clearly demonstrates the value of opening imports and exports to the private sector. [6]

Four additional actions should also receive support. First, the system of warehouse receipts should be fully recognized and encouraged. This will permit farmers as well as traders to responsibly hold stocks to take advantage of seasonal and spatial price advantages. Second, futures markets in all major commodities should be strengthened. This would be a powerful market-compatible means of stabilizing seasonal as well as year-to-year prices. Third, grades and standards should be normalized, strengthened, and enforced. Fair average quality (FAQ) is too loose a standard on which to base either a warehouse receipt system or futures marketing. A system of enforceable grades and standards is essential to active participation in the international market. Such a system would greatly facilitate efficient and effective operation of the domestic market. Supermarkets and processors should be allowed to develop their own systems of grades and standards, which should set the standards for nationwide norms. Finally, it would be very useful to establish a price analysis and forecasting unit within the government to provide information, to be made available to all interested parties on a timely basis, to supplement private sources of information to facilitate planning.

(ii) Target public distribution to the poor, through introduction of food coupons in due course:

While society has an obligation to protect the very poor and vulnerable, it does not have an obligation to subsidize the middle- or high-income classes. [7]

Dev et al. (2004) recommend strengthening the existing PDS through geographical, instead of income, targeting; moving towards self-targeted commodities, in which coarse varieties consumed only by the poor would be distributed; and decentralizing procurement and distribution towards state agencies and Panchayati Raj institutions.

While this would improve the functioning of the PDS, the private sector would still face the same constraints in the supply chain under the current system, as the public sector would still play a large role in the procurement and distribution of foodgrains. The transition of a large public distribution system towards reforms that monetize the consumer subsidy on foodgrains (such as through food stamps) would effectively

[6] See Kumar et al. (2007).
[7] Note that our fourth recommendation in this section suggests that prices be stabilized within bands, which would benefit middle- and high-income consumers.

decouple the public sector's role in grain management from price support to farmers (as would a food-for-work program). In addition, it would also have significant, positive effects on the distribution and quality of grain going to consumers. A further reform could be to move foodgrains with tenders to private firms.[8] By reducing the government's role in the distribution of foodgrains in lieu of cash transfers through coupons or food stamps, the rationale for public sector organizations such as FCI in the procurement of grain would be restricted. It would also be a more cost-effective means of providing transfers to poor consumers.[9]

(iii) Procure foodgrains at market prices, where markets are freed of restrictions on movement, storage, and trade:

The government should no longer use MSP as a basis for procurement for public distribution and for buffer stock, but rather should enter the market, either purchasing directly or using traders as agents for the government. We suggest that the market be freed of movement and storage restrictions and that the private trade be permitted to import and export. If the government cannot procure enough domestically to meet its public distribution and buffer stock needs, it could then import from the international market.[10]

(iv) Stabilize market prices in an open economy environment within a band bordered by c.i.f. and f.o.b. prices by using a variable tariff policy consistent with WTO Rules (within the bound rates):

We propose that market price be stabilized through the use of price bands, in which government intervention in grain markets is determined by fluctuations in world prices—such intervention would only occur if prices rose or fell to certain pre-

[8] Under the present system, wheat or rice used in public distribution in a southern state such as Kerala is likely to be shipped from Punjab. Alternatively, the government could tender to the private trade to deliver a given quantity of wheat or rice (from anywhere the private sector chooses) at a fixed price (presumably based on least-cost).

[9] Dev (2003) found that the cost of transferring Re 1 worth of benefits was lowest in the Integrated Child Development Services (ICDS) program (1.44), followed by the Maharashtra Employment Guarantee (1.85) and the Sampoorna Grameen Yojana (2.28). The PDS faired poorly in such comparisons, with Re 1 worth of benefits costing Rs 6.68 under the PDS. Dev et al. (2004) further noted that in a pilot food coupon scheme in Andhra Pradesh, there was a savings of Rs 90 million per month on subsidized rice sales due to better accounting of the quantities distributed under the program.

[10] The government would not need to export agricultural commodities since stocks for public distribution and buffer should not exceed requirements.

determined ceiling or floor prices, respectively.[11] We suggest that those bands should approximate c.i.f. and f.o.b. prices. Variable tariff policy—raising and lowering tariffs to encourage imports during shortages and discourage imports during surpluses—should be the main instrument to implement the price stabilization.

The MSP would protect farmers from precipitous price falls, and targeted public distributions would protect the poor from precipitous price spikes, should they occur.

(v) For farmers, mitigate the risk of precipitous fall in prices by setting the MSP at A_2/paid-out-cash cost levels:

Reforms needed to promote agricultural diversification include changes in the grain management system to properly align price and production incentives. The presence of MSPs at current levels works against agricultural diversification by assuring very high floor prices for wheat and rice production, while the prices of HVCs are market-driven and more variable within and across seasons. Agricultural diversification would benefit greatly from reforms that adjust the MSP to align resource decisions with proper price incentives.[12]

A number of proposals for MSP reform have been provided, for example, reducing MSPs to C_2 costs and freezing MSPs at current C_2 costs until they reach A_2 +FL costs (World Bank 2003c). Reducing the MSP to current C_2 costs would reduce the total foodgrain subsidy in Punjab by almost Rs 120 billion over a ten-year period if MSP prices are assumed to grow by Rs 10 per quintal, as they have since 2001. While this reduction in MSP would lead to massive budgetary savings, some consider that even this conservative approach to reform may be difficult politically, despite the fact that current market conditions are such that farm-gate prices are well above MSPs in the case of wheat.

It can be observed that, over time, the Punjab farmer has in effect been penalized by having his prices restricted by being isolated from Indian and world markets even though these prices have been guaranteed. We suggest, first, that the purpose of MSP be decoupled from using it to augment income. We suggest that rather than guaranteeing high, stable prices to foodgrains, the MSP should be used to protect against production risk. C_2 costs include an arbitrary imputed return for land, a value that is the result of capitalizing returns to growing wheat and rice. The proper level

[11] This suggestion is also consistent with recommendations made by the World Bank (1999, 2003c).
[12] Note that we are not recommending reduced prices to farmers since they would receive market prices, not MSP.

would be to set MSP at A_2/paid-out-cash costs, which more properly reflects the investment of the farmer. The farmer would receive prices that are set in an all-India market. Historically, the Punjab farmer would have gained more income under this system than under the system of administered prices at MSP level (Mullen et al. 2005). Since Punjab farmers are more productive than farmers in other states, this level would still give them a considerable advantage over other states. It is anticipated that the MSP would not be used much, if at all—and the farmer would still be protected against price risk.

While reforms of the MSP system are welcome to align price incentives appropriately, particularly to promote agricultural diversification, private participation is not necessarily impeded by support prices, if implemented properly. Indeed, in the United States and the EU, the private sector is quite active in the grain sector, despite the presence of loan rates and high support prices, respectively.

(vi) Improve the efficiency of FCI—in part, by making it compete with the private sector on a level playing field, and progressively downsizing the FCI:

Realistically, it is unlikely that the FCI will be abolished. Therefore, the best approach would be to make it accountable and let it compete with the private sector on a 'level playing field', without the many concessions and advantages that it presently enjoys.

Thus, we suggest that the private sector and the public sector have the same rules and regulations for movement, access to transportation, storage, and access to credit.

The costs of the FCI should be transparent and, ideally, be listed as a budget item rather than an ever-expanding credit line.

If public distribution is targeted, the FCI will have a reduced procurement responsibility. If procurement is undertaken through the market, the private sector can do it as well or better than the FCI. And if support prices are set at A_2 costs rather than C_2 costs, and if price stability is implemented primarily through the use of a variable tariff policy, we anticipate that market prices would seldom, if ever, sink to A_2 levels and the FCI would have little need to intervene to support prices. Under these conditions, the FCI would have little, if no, useful role in the state. It should move the bulk of its operations to eastern India to help provide support for increasing production in that under-achieving region of the country. Employment at FCI should be scaled down to be consistent with its level of operation.

5.3 Reform Input Subsidies

Input subsidies pose a constraint to diversification. Subsidies have accomplished the objectives for which they were originally intended. Fertilizers, irrigation, and electric power are now being provided at low, sometimes zero, costs. But:

- Subsidies are promoting input-intensive agriculture, specifically what and rice.
- Productivity of wheat and rice is stagnating (marginal returns to fertilizers and water are low).
- The distribution of benefits is increasing inequalities in incomes and between regions. Because of landholding distribution, the largest amount of subsidies goes to medium and large farmers despite the fact that the subsidies have been justified, in part, to benefit the smallholder.
- The effectiveness of institutions supplying irrigation and power is being severely compromised. State organizations, such as the State Electricity Board (SEB), are being bankrupted, progressively providing poorer quality services.
- Resources are being misallocated (paddy is being sown too early, too much nitrogen is being applied relative to phosphorus and potash, too much water is being pumped and applied, especially on rice) and the environment is being harmed—the water table is declining rapidly in the central region and increasingly land is being lost to salinity (especially in the south-western region where almost 16 percent of net irrigated area is degraded due to seepage from canals and/or excessive irrigation).
- Costs are massive and mounting rapidly, diverting budgetary support from higher return investments that could support diversification.

As regards the irrigation and power sectors, we find ourselves in a Catch-22 situation (Gulati and Narayanan 2003: 165). Given that the input-supplying institutions are in financial doldrums, as is the state that must ultimately bear the burden of the subsidy, it is imperative that these agencies recover the costs so that they become financially viable. This would entail a manifold increase in water and power rates. However, farmers would be unwilling to accept such a step unless they derive some benefit in terms of better delivery of the input. For this to happen, the physical conditions of the irrigation systems and the power generation/transmission/distribution have to be improved. However, this is itself predicated on the availability of funds on the one hand and institutional overhaul on the other. Focusing on reforming prices has not

worked in the past because attention was not paid to also reforming institutions. The goal should be to provide reliable services at affordable prices.

To achieve this, we suggest the following:

(i) Reprice fertilizer:

The subsidy on fertilizer is huge. In addition, fertilizer is being applied on wheat and rice at or above the recommended levels, and fertilizer components are out of balance (too much nitrogen relative to phosphorus and potash). The marginal responses to fertilizer are low, if not negative, and wheat and (especially) rice yields are stagnating.

- Dismantle the Retention Price Scheme that increasingly rewards the industry rather than the farmer: The Retention Price Scheme (RPS) aims at ensuring a reasonable return on investment. Domestic producers are given a designated, plant-specific retention price, which is derived essentially through a cost-plus formula. The fertilizer subsidy given to the firm is the difference between the retention price and the farm-gate price of fertilizer. Based on the difference between farm-gate prices and domestically-produced fertilizer relative imports, although the actual farmer share varies yearly due to fluctuations in world prices, the subsidy share of farmers between 1981–82 and 1999–2000 was approximately 66.5 percent while that of industry was 33.4 percent (Gulati and Narayanan 2003). However, over the six-year period from 1998–99 to 2002–03, the farmer's share declined significantly, from nearly 90 percent to 57 percent. In effect, the RPS subsidizes a very inefficient domestic fertilizer industry.
- Revamp agricultural extension services to educate farmers on balanced use of NPK: The relevance and effectiveness of the agricultural extension service has been increasingly compromised as a result of inability to adapt to changing needs. Linkage with research is weak, operating budgets are limited, and accountability is limited. The system is ill suited to meet the demands of a market-driven and diversified agriculture. A partial answer may be to limit the responsibilities of the public sector system; focusing on recommending economic and balanced use of major nutrients might be one priority. A second answer may be to privatize certain responsibilities. A third response might be to actively encourage and perhaps even provide incentives to the private sector to increase their extension efforts, in order to increase sales.
- Bring fertilizer prices more in line with economic costs: In 2001, the Expenditure Reform Commission (ERC) recommended that urea price be increased each year by 12 percent over the eight years from the base 2001–02 in order to bring

retention price at par with the international price. The motivation was to enforce efficiency in the urea industry to make it globally competitive. Raising the price of fertilizer could decrease production and increase farmer costs. Equity was a justification for the subsidy; the proportion of marginal and small farmers is significant in Punjab (30 percent approximately), many are in economic distress, and a given reduction in fertilizer subsidy through price hike may affect them adversely to a great extent. Three scenarios were considered, each involving a 5 percent price hike of fertilizer in the base year (2006–07) for the next five consecutive years:[13] without any new policy initiative to improve fertilizer use efficiency (Scenario I); improving fertilizer efficiency through use of LCC[14] (Scenario II); and improving fertilizer efficiency through use of LCC supplemented with increased extension efforts (Scenario III).

- Effect on NPK consumption and subsidy: A 5 percent hike in fertilizer price in 2006–07 could lead to a fall of 0.21–0.39 million tons in the consumption of fertilizer (NPK) in the terminal year 2011–12 (see Appendix Table A5.2). This would reduce fertilizer subsidy over the five years by one-third (Rs 3,484 million) to Rs 6,442 million.
- Impact on farmers: The cumulative per ha cost of fertilizer will increase by Rs 972 for wheat and by Rs 488 for rice by the end of the terminal year under Scenario III. This could lead to lower profitability and may lead to opposition by farmers. The required increase in yield for wheat of 0.22 quintal per ha could be obtained through improvement in cultivating practices. Alternatively, a small (0.53 percent for wheat) increase in price could neutralize the rise in the cost of fertilizer. An increase in fertilizer price should induce efficiency gains in its use along with introduction of LCC and balanced use of fertilizers.
- Impact on food production: A reduction in fertilizer consumption of 2.5 percent in wheat and 3.3 percent in paddy due to 5 percent increase in fertilizer price will affect cereal yield adversely. Under Scenario I (fertilizer price hike without measures to improve fertilizer use efficiency), yields tend

[13] See Vashishtha and Gupta (2006) for details. Another scenario is feasible, viz. when factor substitution takes place (change in input combination, e.g. labor or water and/or electricity get substituted for fertilizer) due to change in relative prices of inputs as a policy measure of 5 percent hike in fertilizer price.

[14] LCC refers to Leaf Color Chart, which can result in saving of 15–20 kg per ha of N in wheat and paddy.

to decline continuously. The decline in yield under Scenario II is slower than that under Scenario I by using a LCC to help maintain yield with saving in N. When the saving on N is ploughed back into the system through improved extension (and that is a big assumption), the yield falls slowly but remains at higher level than the yield in Scenario II in successive years. The contrasting situation between Scenario II and Scenario III is that in the latter, the ploughback of fertilizer saving arrests the fast decline in yield. Assuming that the area under wheat and rice remains unchanged, under Scenario I, the cumulative decline in cereal output over five years will be 1.21 million tons (0.56 million tons for wheat plus 0.65 million tons for rice). Under Scenario II, the cereal output declines by 0.92 million tons (0.54 million tons for wheat plus 0.39 million tons for rice). Scenario III not only averts a decline but also leads to an increase in cereal production of 0.29 million tons (0.14 million tons for wheat plus 0.15 million tons for rice). It is clear that a hike in the fertilizer price poses some risk to food production unless accompanied by a substantial improvement in fertilizer use efficiency plus ploughing back the gains into the system.

(ii) Reform irrigation:

While the subsidy on irrigation is not huge, the irrigation system has not been generating enough O&M revenue to maintain the system, hence irrigated area is being lost. Salinity has been increasing, hence the quality of cultivated area has been deteriorating.

- Focus on better utilization of the irrigation potential already created: The investment cost of adding new canal irrigation is just too large and the potential gains are too marginal to seriously consider creation of further potential of the major and medium irrigation schemes in Punjab.
- Establish and promote water-user associations to improve maintenance and equitable allocation of water, make them truly participatory, and devolve powers by the irrigation department: The overhead costs of the irrigation department are high, which is one of the reasons for poor maintenance of the canal system. If Water Users Associations (WUAs) are formed and promoted in the canal command areas and if the irrigation department transfers a major part of the recovery of O&M expenses, the WUAs could be entrusted with the job of maintenance of channels and watercourses. WUAs could also be authorized to award small contracts to private parties for minor works subject to the audit by the irrigation department. The department could offer technical advice to WUAs as the

latter may not have this kind of expertise. The decentralization of responsibility and devolution of financial powers to WUAs may go a long way to bring about the necessary institutional changes for reforming the canal administration and improving the maintenance of the canal system.

Forming WUAs will be the first step in the right direction of institutional change but it may not be sufficient to resolve many other issues such as inequity in the distribution of canal water (tail-enders not getting their due claim of water as compared to those located at the middle and upper reach). Proper representation of tail-enders in the main body of WUA could be a feasible way to do justice to tail-enders. Not only would the tail-enders be able to receive appropriate amounts of water but, in the long-run, they may be asked to pay different water rates than the farmers located in the middle and upper reaches. The WUAs could be made responsible for collecting water charges and, in turn, they could be rewarded for efficient collection of canal irrigation dues. Where rural societies are not homogeneous in terms of caste and/or the social/political power, some divisions in WUAs are bound to come up and these bodies may be initially dominated by the socially/politically powerful elite groups. The experience of the neighboring state of Haryana suggests that redressal of grievances of tail-enders and other deprived farmers depends on their proximity to the local public representatives or MLAs (Vashishtha 2003).

- Gradually increase pricing to at least cover operations and maintenance (O&M) costs: Irrigation water charges contributed less than 13 percent of the O&M expenses in 2003–04. The last revision of water charges was done in 1993–94 (from Rs 14.83 per ha to Rs 98.84 per ha).[15] The water tariff was abolished in 1997. The present system is financially unsustainable, a clear implication of which is progressive loss of irrigated area.

  A marginal increase in water rates will not significantly affect the demand for water in the major cereal crops (wheat and paddy). It is suggested that the Punjab government should revert back to at least the 1993–1994 level of irrigation rates (or say, approximately Rs 50 per ha) of net irrigated area on average, taking into consideration the variation in water rates across crops, season, nature of projects, etc.[16] The average water rate of Rs 50 per ha of net canal irrigated area would imply Rs 100 per ha of gross canal irrigation area, which would give receipts of Rs

[15] Water rates vary according to crop, season, and type of projects, see http:www.Indiastat.com/India/showtable_pr.asp?, accessed December 21, 2005.
[16] For new projects launched with the help of loans from international agencies, Andhra Pradesh has decided to raise charges up to Rs 500 per ha to recover O&M expenses.

100 million (approximately),[17] which could in turn help finance about 10 percent of the O&M expenses (in 2003–04, Rs 971 million was 10 percent of the O&M expenses) (Vashishtha and Gupta 2006). Thus, a beginning should be made to recover part of the O&M expenses through revision of water rates.

- Devolve solution to local/sub-zonal problems to correct regional inequalities: The solution applicable to regions with different problems must incorporate the peculiarities of the particular zones/sub-zones. For example, the northeast part of Punjab has less benefit from canal irrigation than the Central and Southwest zones. The water table is very deep, resulting in high cost of groundwater. In the South zone, the salinity as well as the water table is high. Seepage resulting from canal irrigation continues to aggravate the situation. In the central zone, the water table is depleting rapidly due to over-exploitation of groundwater.

  The irrigation department should give priority to lining canals to reduce seepage in the southwest zone. In the central zone, tubewells in the command area could be brought within the jurisdiction of WUAs to regulate the water usage. WUAs could also play an important role to help line the canals in the southwest zone, provided the irrigation department involved them in this endeavor. In the north zone, the jurisdiction of WUAs could cover not only the canal command areas but also the tubewell areas in close collaboration with the Punjab State Tubewell Corporation (PSTC), which in the earlier years was active in sinking and maintaining deep tubewells but more recently, owing to its inefficiency and low power rates and/or many concessions on power rates, has gone virtually financially defunct. WUAs can play important roles not only in collaborating with PSTC to revive this ailing public sector unit but also in making watershed management a great success in the north-east region, which has high stakes in the success of agriculture.

  These steps are not necessarily mutually exclusive. They can be pursued simultaneously. However, the sequencing of options is important. For example, forming WUAs, making them truly participatory, and giving due weight to the peculiarities of incorporating solutions to local problems are important prerequisites for success. Moreover, reforms in the irrigation sector need to be pursued in conjunction with reforms in the power sector**.**

[17] The net canal irrigated area in 2003–04 was 999,000 ha.

(iii) Reorient power:

While the cost of the power subsidies is huge, the marginal gains from power are small and the benefits accentuate regional and income inequalities. The SEB is bankrupt and cannot make investments necessary to improve the quality of power. However, most worryingly, environmental problems created by subsidized power—particularly the depleting water table, due in large part of early sowing of rice—are serious, since the depleting water table cannot be replenished.

- Establish and promote user committees to monitor quality improvements in power distribution: Farmers are often suspicious of tariff rates being raised once the meters are fixed at the individual level. It is basically the mistrust of the government or the SEB that leads the majority of farmers to be skeptical of any technical solution offered by the Board, for the past experience of the farmers shows that (a) people tend to seek solution to the huge backlog of requests for agricultural connections outside the legal framework; (b) the nexus between the influential farmers and the corrupt officials of the electricity department leads to tremendous loss to the electricity board and at the same time, it keeps the majority of farmers (especially, small and marginal) outside this nexus; (c) the maintenance of the transformers is tardy (many transformers often show oil leakages) and the lines are badly maintained by the electricity department. In order to elicit the cooperation of the farmers, user committees should be formed and promoted and the collective responsibility of the committee be fixed. User participation could be strengthened by evolving a dispute settlement mechanism, for example, by involving the user committee in resolving the issues relating to wrong billing or poor/unreliable electricity supply with the representatives of the monitoring committee of the SEB or the representatives of the State Electricity Regulatory Commission (SERC).
- Dismantle/unbundle the State Electricity Board and privatize parts—generation, transmission, and/or (especially) distribution—of its components with the objective of improving quality: The SEB is in financial doldrums. Without additional funding, it cannot invest to improve quality. However, even with additional funding, it may not be able to improve quality. The large level of theft is one obvious example of its deficiencies. One option to seriously consider would be to unbundle the SEB—generation, transmission, and distribution—and sell off parts that are most attractive to private operators. Distribution would seem to be particularly attractive; the private sector has a far better reputation for accountability than does the public sector.

- Introduce variable pricing for peak/slack periods, using metering:[18] Competitive populism has emboldened the farming community in Punjab to demand scrapping of any tariff on power consumption for agriculture. After a few years of free supply of electricity to agriculture (1997–2002), a nominal tariff of 50 paise (or Re 0.50) was fixed in 2002–03 which has not been raised since then.

  Surveys indicate that farmers would be willing to pay higher costs if quality were to be improved. Therefore, improvement in quality would seem to be essential to carry out a pricing reform. Recovering from agriculture a higher proportion of the average unit cost of supply of power, the average electricity consumption would decline alongside raise in the tariff rate.[19] At any reasonable degree of price hike, the additional expenditure to the average farmer would not be a huge proportion of the total cost of production.[20]

  When the prominent crop rotation (wheat–paddy) is considered together, farmers tend to gain through factor substitution, that is shifting crops and changing practices. The GOI would save on the fertilizer subsidy. As industrial users pay much higher tariff (per unit) than households and farmers, an increase in tariff for agricultural users would help reduce the overall deficit of PSEB and/or reduce the tariff rate for industrial use. In addition, there would be a big gain in terms of (a) preventing further over-exploitation of groundwater; and (b) inducing crop diversification or, at least encouraging farmers to reduce the area under paddy.

  One major requirement to correctly implement pricing schemes is knowledge of how much electricity is consumed by each type of farmer, i.e. the existence of metering devices. An innovative strategy of prepaid meters could be implemented. With the prepaid meter system, clients buy a certain amount of electricity and are given a digital code that they punch into their meter, upon doing which they are immediately provided electricity. Currently this is being implemented in other countries with significant success (in Canada and Peru, for example). As a result, farmers would be able to control their energy consumption, they could buy

[18] Including significantly raising rates for use during May–June in order to reduce groundwater discharge and stem the fall in the water table.

[19] Electricity consumption would be expected fall over time at the rate of 3 percent for each 10 percent hike in tariff.

[20] For example, targeting to recover at least 50 percent of the average unit cost of supply of power by 2013–14—a hike of 50 percent over the present rate with hikes of 10 percent per annum after that—would lead to a decline in the average electricity consumption from 592 units per ha in 2006–07 to 451 units per ha in 2013–14. The additional expenditure to the average farmer would be Rs 50–60 per ha in 2006–07 and total expenditure would reach only Rs 250–300 per ha in 2013–14 (Vashishtha and Gupta 2006).

electricity in small amounts, and there would be a minimum monthly fee prevalent in traditional electric systems. In addition, consumers would not develop a debt, for which they would have to incur interest, since it is a fee-for-service system.

Although it would be ideal to install electric meters first to implement these price schemes, starting with installing the meters may not be politically feasible. A progressive approach towards electric meters based on land-size could give incentives to farmers to accept meters. Specifically, if a farmer believes that prices through the proposed mechanism re not up to his satisfaction then he might have the incentives to ask for a meter so that he may be charged for exactly the amount consumed by him.

Thus, a modest hike in electricity tariff can be expected to:

- Increase income of farmers (without reducing output or without risk to food security);
- Reduce cross-subsidy on power to agriculture or increase revenue of PSEB;
- Reduce subsidy on fertilizer;
- Induce farmers to reduce the area under paddy, thereby encouraging crop-diversification; and
- Prevent/discourage over-exploitation of groundwater.

The enhanced revenue can be used for improving the distribution and transmission network, thereby improving the supply of electricity.

- Target subsidies (perhaps using pre-paid cards) to smallholders: An alternative strategy of price discrimination could be based on the size of the farmers plot and on the implementation of a series of possible two-part tariff mechanisms. In order to be able to successfully engage in price discrimination, the following conditions must hold: the firm must have some degree of market power in such a way that it can establish different prices; the firm must be able to identify consumers based on which they can discriminate; and no resale can occur (no arbitrage) because through re-sale the effects of price discrimination will end being perverse. All of these assumptions clearly hold.

  One additional advantage of metering is that it would also allow better targeting of the subsidy to specific farmer groups. In that sense, subsidized pre-paid cards can be directly assigned, allowing for perfect targeting of the subsidy.

- Sequence reforms: The rationalization of tariff rates can be done only if certain preconditions are met. For example, the unfunded liabilities of the PSEB cannot be allowed to continue. The manner in which the losses of PSEB will be funded needs to be made transparent. The way it is planned to be done should be acceptable to the stakeholders. Alternatively, unbundling might shift distribution to the private sector, which might have higher credibility and a 'honeymoon period' of trust during its early years of operation. Any schemes of tariff rationalization have a chance of success only if the stakeholders perceive that the reform process is likely to improve the quality of supply in a significant fashion.

  The core of the reform process consists of the following four elements (NCAER 2003):

  (a) functional unbundling and re-organization (perhaps, privatization);

  (b) distribution reforms;

  (c) open access to the network to encourage competition, and

  (d) regulatory predictability.

  It is imperative for the state government to lay down the strategy as a part of the transition process to achieve the above objectives. For example, enacting enabling legislation is crucial for starting the process of restructuring. The next step is to facilitate open access to the transmission and distribution network, for this activity is crucial for improving supply of electricity and reducing costs. A detailed road map for the reform process needs to be laid down clearly (NCAER 2003).

  A review by Credit Rating Information Services of India Limited (CRISIL) and Investment Information and Credit Rating Agency of India (ICRA) of the performance of Punjab with regard to different parameters in 2005 shows that the state performs poorly with respect to the steps taken by the Government of Punjab (score: 3.54 out of 17), SERC related parameters (score: 5 out of 15), and financial risk analysis (score: 5.13 out of 20). The overall score of Punjab is 36.82 out of 100, which is a poor reflection of the initiatives taken by Punjab government and SERC (see Appendix Table A5.3). The performance of Punjab is far worse than of Andhra Pradesh, which scores 57.03 out of 100.

  Punjab has some strong points in the context of electricity reform. For example, (i) Punjab has achieved 93 percent household electrification, (ii) the trend in commercial viability has shown positive signs, with profits reaching Rs 1,740 million in 2003–04, and (iii) the percentage of energy billed (53 percent) on

metered basis is moderate in 2003–04. On the other hand, the major weak points of PSEB still persist, such as (a) absence of energy audit, (b) meeting a large component of subsidy support from GOP through interest set-offs on government loans and not in cash, thus leading to PSEB starving for resources for investment, (c) large defaults on loans of the government as well as on external loans; and (d) very slow reduction in high manpower in the power sector. Nonetheless, Punjab has a long way to go to catch up in this process. The Government of Punjab must take steps to expedite reform and put them in proper sequence prior to implementing tariff reform to improve the financial health of the sector.

5.4 Our Vision

Looking into the future, we envision several features of a successful Punjab agriculture:

- Strong agricultural research at the Punjab Agricultural University (PAU) on HVCs (including upgraded quarantine procedures to facilitate import of technical materials until the research system becomes more active).
- Modern processing plants located throughout the state, using kinnows and sweet oranges to produce juice, potatoes to produce chips, tomatoes to produce ketchup, milk to produce cheese and ice cream, sugar cane to produce sugar, maize to produce ethanol and poultry feed, etc.
- Bakery hubs around major *mandis* to process available wheat and dairy.
- Modern processing and retailing institutions, such as business-oriented cooperatives, contract farming, and supermarkets linked to farmers through utilizing direct purchases from farmers, using contract arbitration of disputes, employing a range of risk mitigation strategies (insurance markets, storage infrastructure), and benefiting from direct foreign investment in food processing and retailing.
- Improved infrastructure, including:
    - Cold storage chains[21] (cold storage and refrigerated vans) located at selected *mandis* to hold and move perishable commodities to extend shelf-life and protect against excess production and price collapse.

[21] Electric power, currently monopolized by agriculture, would arguably have high marginal returns applied to cold storage chains.

- Improved highways/rail lines directly to major ports to facilitate exports to overseas countries.
- Improved highways to the Pakistan border to facilitate exports to Pakistan (and on to Afghanistan).
- International airport at Amritsar to facilitate exports to the Gulf countries, EU, and Central Asia.

- High-value commodities and a broader mix of traditional commodities accounting for 60 percent of Punjab agriculture and wheat and rice accounting for 40 percent.

  We are confident that this would result in the highest per capita income, lowest poverty, and the most robust environmental sustainability among Indian states. The challenge is how to get to there from here.

5.5 The Way Forward

Punjab agriculture was an undisputed leader in the Green Revolution, and the Punjab farmer was acclaimed the world over. Today, however, Punjab agriculture no longer plays the leadership role that others would want to emulate. In fact, it has reached a point where it must undergo significant changes if the state is to move forward in agriculture.

So long as the government continues to contract for wheat and rice at high, stable prices, the marketing system is geared to wheat and rice, price subsidies for power and irrigation favor water-using crops, and the research system focuses on wheat and rice, all the incentives are stacked in favor of wheat and rice. However, demand for wheat and rice is slowing perceptibly. Little additional land can be sown to wheat and rice. Yields of wheat and rice are stagnating. Thus, increases in incomes from wheat and rice are limited, even in the short run. Add to this, the declining water table, increasing salinity, deteriorating soil nutrition, the increases in incomes are even more limited, if not reversing, in the longer run. Keeping on the same course or not making any changes will lead to an unattractive future.

Diversification could be the answer, but would require fundamental changes in incentives, institutions, and investments. If Punjab does not rationalize incentives, create new institutions and reinvigorate the existing institutions, and increase investments significantly, it will suffer declining income and employment and irreversible environmental degradation. This prospect gives rise to a number of questions: How can the Punjabi farmer again become a role model? Why is the

process of change not moving faster and how can it be accelerated in an inclusive manner?

We offer these recommendations, ideally to be implemented as a package. We do this because the political process will require trade-offs among winners and losers in particular activities.

We understand that when change does not take place, there are reasons for it. We recognize that reforms can be hindered by the fact that important stakeholders as well as researchers can have rather different, and often opposing, views about essential facts, causal mechanisms, and appropriate policy solutions (Birner et al. 2007). For example, we recognize that not all parties accept that the falling water table is the direct result of subsidized electric power or that subsidized electric power is leading to early sowing of paddy.[22] The popular perception is that high transactions costs for metering, necessary to enforce pricing reforms, would be prohibitive.[23] However, perception can be as real as reality; these parties do not accept the causal relationship that might justify increasing electric power rates or the technical means to reinforce higher rates. This dilemma calls for a concentrated effort to lay all the evidence on the table, debate it openly, identify differences, and then see if they can be reconciled. Open communication is especially vital to effective policy change.

We recognize that policies which, by themselves, seem inappropriate appear to be less inappropriate when examined in the context of off-setting other policies. For example, Indian policies such as those related to import restrictions, movement restrictions, and levies generally have suppressed foodgrains prices to respond to consumer concerns. Input subsidies have been justified as a means of providing profits. This policy combination has been described as 'one foot on the brake and one foot on the gas peddle'. Another example is the justification for subsidies as benefiting the small and marginal farmers. In these cases, reform would be difficult without offsetting changes in the other policies.

---

[22] Alternative policy options to reduce the amount of electricity consumed include:

(i) promotion of energy-saving devices such as capacitors or more efficient motors, using (a) incentives or (b) regulators (note: this would not necessarily reduce groundwater depletion);
(ii) Further restrictions on the amount of electricity supplied to agriculture (rationing) by (a) reducing the hours of supply or (b) adjusting the supply better to crop needs;
(iii) Promotion of less water-intensive crops using (a) restrictions or (b) incentives such as the promotion of crop diversification;
(iv) promotion of water-saving practices in paddy cultivation;
(v) expanding and/or improving the efficiency of canal irrigation, as a means to reduce the need for groundwater irrigation.

Each of these options introduces issues that would have to be addressed. See Birner et al. (2006).

[23] Technical experts do not foresee this as a major problem.

We also recognize that some policy changes may be more controversial than others. For example, unbundling of generation, transmission, and distribution may not be so controversial as compared to privatization of the functions. Increasing power rates in return for guarantees of improved quality or increasing irrigation rates in return for more user control and higher O&M may be less controversial. And increasing surface irrigation to reduce groundwater needs or increasing research and extension would probably not be controversial but would face budget constraints. This dilemma calls for a concentrated effort to identify who is for what and why, debate it openly, identify differences if any, and then see if they could be reconciled.

Finally, we recognize that some policies, for example, the fertilizer subsidy or the MSP, are national responsibilities while others, for example power or irrigation pricing, are state responsibilities. Putting together packages of these policies would involve working simultaneously at several levels of government, with a wide range of interest groups.

The sequence in which activities are undertaken often becomes very important in the planning process. As with most approaches that seek to encompass a system in a holistic manner, the number of factors that have to be investigated in the agricultural sector are large indeed. Everything cannot be done everywhere at the same time and resources—financial and human—are scarce. Necessary changes in some policies that are not possible immediately may be possible after other changes have been undertaken.

The dilemma can be resolved by focusing on key activities. Our package is large. It is, in our view, a set of first-best solutions. In our list of priorities, the highest priority would be placed on (i) reform of the public foodgrains marketing system[24]—particularly decoupling of MSP and procurement, which could leave ample profitability for wheat and rice producers while making HVC more competitive for returns—and consequent strengthening of the private marketing system and (ii) facilitating the operation of new institutions and strengthening the linking of farmers to processors and retailers, which would unleash a wave of HVC value-added activity to satisfy the rapidly growing demand. We place high priority on reforming subsidies but even higher priority on 'getting the institutions right' before or simultaneously with 'getting the prices right'.

Punjab agriculture is clearly at a crossroad. All incentives at present are stacked in favor of wheat and rice. Incomes are stagnating in the near-term. While the situation is

[24] Mainly the responsibility of the national government.

not yet at a crisis, in the longer term, however, changing demand and deteriorating environment will lead to progressively decreasing incomes. Keeping to the current course does not promise an attractive future. Change is imperative and the relevant question is not ‘when’ but ‘what’ and ‘how’ it should be done. Whether Punjab can make the required changes to regain its leadership role in agriculture remains to be seen.

Appendix Table A5.1: Market Fees and Taxes in Punjab

Type of charge	Current rate (%)	Reduced rate for contract farming* (%)	Collecting agency
Market fee	2	0	Mandi Board
Rural Development Fund	2	0	Rural Development Board
Infrastructure Tax	1	0	Rural Infrastructure Board
Purchase Tax	4	4	State Treasury
Commission	2.5	0	Commission agent
TOTAL	11.5	4	

Note: * Reductions are also provided to wheat and rice processors and to newly-established horticulture buyers not engaged in contract farming for a period of four years.
Source: World Bank (2003c).

Appendix Table A5.2: Effect of Price Hike of Fertilizer and Policy Intervention over a Period of Five Years

Item	Cumulative change over base year* under different scenarios		
	Scenario I	Scenario II	Scenario III
Change in cereal production (million tons)			
Wheat	-0.56	-0.54	0.14
Rice**	-0.65	-0.39	0.15
Wheat + Rice	-1.21	-0.92	0.29
Change in fertilizer consumption			
Wheat			
Per ha (kg)	-82.6	-153.9	-82.6
Total ('000 metric tons)	-284.3	-530.0	-284.3
Rice			
Per ha (kg)	-84.8	-155.0	-84.8
Total ('000 metric tons)	-215.7	-394.3	-215.7
Change in fertilizer subsidy (Rs million)			
Wheat	-1,981	-3,694	-1,981
Rice	-1,503	-2,748	-1,503
Total	-3,484	-6,442	-3,484
Change in cost of fertilizer per ha (Rs)			
Wheat	972	13	972
Rice	488	-455	488
Change in total cost of fertilizer (Rs million)			
Wheat	3,346	44	3,346
Rice	1,242	-1,156	1,242
Total	4,588	-1,112	4,588
Change in value of production (Rs million)***			
Wheat	-3,585	-3,426	907
Rice	-5,490	-3,268	1,279
Total	-9,075	-6,694	2,187

Notes: Three scenarios were considered, each involving a 5 percent price hike of fertilizer in the base year (2006–07) for the next five consecutive years: without any new policy initiative to improve fertilizer use efficiency (Scenario I); improving fertilizer efficiency through use of LCC (Scenario II); and improving fertilizer efficiency through use of LCC supplemented with increased extension efforts (Scenario III).

* Base year 2006–07. Price hike effective from 2007–08; Terminal year is 2011–12.

** The corresponding figures for paddy in Scenarios I, II, and III are -0.98, -0.59, and 0.23 million tons respectively (one ton of paddy = 0.66 ton of rice).

*** Based on the Minimum Support Price (MSP) of wheat (Rs 640 per quintal) and paddy (Rs 560 per quintal) for the year 2004–05. It is assumed to remain constant for the period 2004–05 to 2008–09.

Source: Vashishtha and Gupta (2006).

Appendix Table A5.3: Scores Assigned to Punjab Electricity Department, 2005

Parameter	Maximum score	Score assigned for Punjab
State government related parameters	17.00	3.54
SERC related parameters	15.00	5.00
Business risk analysis:		
- Generation	6.00	4.50
- Transmission and distribution	21.00	9.10
Financial risk analysis	20.00	5.13
Others	5.00	0.25
Progress in attaining commercial viability	16.00	9.30
Total	100.0	36.82

Note: The implementation of each parameter is given in ICRA and CRISIL (2005).
Source: ICRA and CRISIL (2005).

References

Alagh, Y. K. 2000. 'Agriculture and Economic Growth: Subsidies and Trade Policies'. *Agricultural Situation in India*, Directorate of Economics & Statistics, Department of Agriculture & Cooperation, Ministry of Agriculture, August.

Ali, A. M. M and I. Jahan. 2003. 'Public Food Distribution System (PFDS) in Bangladesh: Successful Reforms and Remaining Challenges'. Paper prepared for the Workshop on 'Agribusiness: From Parastatals to Private Trade-Why, When and How?' organized by IFPRI jointly with Centre for Economic and Social Studies, Hyderabad in New Delhi, December 2003.

ANZDEC. 2005. 'India Agribusiness Development Support Project'. Report prepared for the Department of Agriculture and Cooperation, Ministry of Agriculture, India and the Asian Development Bank.

Aulakh, M. S. and G. S. Bahl. 2001. 'Nutrient Mining in Agro-climatic Zones of Punjab'. *Fertilizer News*. Vol. 46, No. 4, pp. 47–61

Bajwa, M. S. 2002. 'Strategies for Agricultural Research and Development – A Plan for Punjab'. in S. S. Johl and S. K. Ray (eds), *Future of Agriculture in Punjab*, Centre for Research in Rural and Industrial Development, Chandigarh.

Banerji, A. and J. V. Meenakshi. 2004. 'Buyer Collusion and Efficiency of Government Intervention in Wheat Markets in Northern India: An Asymmetric Structural Auctions Analysis'. Working Paper No. 104, Centre for Development Economics, Delhi School of economics, University of Delhi, Delhi, India.

Bansil, P. C. 2003. 'Demand for Foodgrains by 2020 AD', in S. M. Dev, K. P. Kannan and N. Ramachandran (eds), *Towards a Food Secure India: Issues and Policies*. Institute for Human Development, New Delhi.

Birner, Regina, Surupa Gupta, Neeru Sharma and Nethra Palaniswamy. 2007. 'The Political Economy of Agricultural Policy Reform in India: The Case of Fertilizer Supply and Electricity Supply for Groundwater Irrigation'. International Food Policy Research Institute, New Delhi.

Business Line. 2006. August 30, http://www.hindubusinessline.com/2006/08/30/stories/2006083003090800.htm, Accessed December 27.

Centre for Monitoring Indian Economy (CMIE). 2005. 'Agriculture'. Centre for Monitoring Indian Economy, Mumbai.

Chand, R. 2002. *Government Intervention in Foodgrain Markets in the New Context*. Report to the Ministry of Consumer Affairs, Food and Public Distribution, Government of India, National Centre for Agricultural Economics and Policy Research (NCAP), New Delhi.

Chawla, K. S. 2006. 'Punjab set to revive cotton glory'. *The Tribune*, Chandigarh, December 26.

Chopra, R. N. 1981. *Evolution of Food Policy in India*. MacMillan, Delhi.

Chowdhury, S. and M. Torero. 2007. 'Power and Irrigation Subsidies in Andhra Pradesh and Punjab'. Unpublished manuscript, International Food Policy Research Institute, Washington, D.C.

Dawe, D. 2002. 'The Changing Structure of the World Rice Market, 1950–2000'. *Food Policy*. Vol. 27, No. 4, pp. 355–370.

Dev, S. M. 2003. 'Food Marketing Parastatals and Social Safety Net Programmes: The Case of Public Distribution in India'. Paper prepared for the Workshop on 'Agribusiness: From Parastatals to Private Trade-Why, When and How?' organized by IFPRI jointly with Centre for Economic and Social Studies, Hyderabad in New Delhi, December 2003.

Dev, S. M., C. Ravi, B. Viswanathan, A. Gulati and S. Ramachander. 2004. 'Economic Liberalism, Targeted Programmes, and Household Food Security: A Case Study of India'. MTID Discussion Paper No. 68, International Food Policy Research Institute, Washington, D. C.

Dhaliwal, K. S. 2003. 'Partnership of Nestle with Milk Producers in India'. Paper presented at the International Workshop on 'Agricultural Diversification and Vertical Integration in South Asia', organized by International Food Policy Research Institute jointly with Federation of Indian Chambers of Commerce and Industry (FICCI) in New Delhi, November 2003.

Dhatt, A. S. and B. S. Ghuman. 2000. 'Export and Distant Marketing of Punjab Vegetables'. Technical Report No. TR4, Punjab Horticultural Postharvest Technology Centre, Punjab Agricultural University, Ludhiana.

Eliot, John. 2006. 'India's field of greens: The country is undergoing a second agricultural revolution—building the infrastructure that connects farm to supermarket', *Fortune*, August 30, money.cnn.com.

Fan, S. and A. Gulati. 2004. 'Investments and Subsidies in Indian Agriculture: How can India Rationalize its Spending in Agriculture?'. Paper prepared for the Workshop on 'Re-energizing Agriculture in India', organized by Rajiv Gandhi Institute for Contemporary Studies (RGCIS), World Bank, and International Food Policy Research Institute (IFPRI), New Delhi, December 17.

Fan, S., P. Hazell, and S. Thorat. 1999. 'Linkages between Government Spending, Growth, and Poverty in Rural India'. Research Report No. 110, International Food Policy Research Institute, Washington, D. C.

FAOSTAT. Database of the Food and Agricluture Organization of the United Nations, http://faostat.fao.org/site/336/default.aspx.

Government of India. 1992. 'Report of the Committee on Pricing of Irrigation Water'. (Vaidyanathan Committee Report), Planning Commission, Government of India, New Delhi.

——. 2002a. National Water Policy 2002. Ministry of Water Resources, Government of India, New Delhi. Available at http://wrmin.nic.in/policy/nwp2002.pdf.

——. 2002b. 'Annual Report on the Working of State Electricity Boards and Electricity Departments'. Power and Energy Division, Planning Commission, Government of India, New Delhi.

——, 2002c. *Tenth Five-Year Plan, 2002–07.* Volume II, Planning Commission, Government of India, New Delhi.

——. 2002d. 'Report of the High Level Committee on Long Term Grain Policy'. Department of Food and Public Distribution, Ministry of Consumer Affairs, Food and Public Distribution, Government of India, New Delhi.

——. 2002e. *Bulletin on Food Statistics (1998–2000).* Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi.

——. 2002f. Annual Report 2001–02. Tata Study. Ministry of Consumer Affairs, Department of Food and Public Distribution System, Government of India, New Delhi.

——. 2002g. National Water Policy 2002. Ministry of Water Resources. http://wrmin.nic.in/policy/nwp2002.pdf, accessed on June 7, 2004.

——. 2002h. Punjab Development Report. Planning Commission, Government of India, New Delhi.

——. 2004. 'Central Government Subsidies in India'. Ministry of Finance, Department of Economic Affairs, New Delhi.

——. Various years. *Agricultural Prices in India*. Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi.

——. Various years. *Agricultural Statistics at a Glance*. Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi.

——. Various years. *Economic Survey*. Economic Division, Ministry of Finance, Government of India, New Delhi.

——. Various years. *National Accounts Statistics*. Central Statistical Organisation, Ministry of Statistics and Programme Implementation, Government of India, New Delhi.

——. Various years. *Reports of the Commission for Agricultural Costs and Prices*. Department of Agriculture and Co-operation, Ministry of Agriculture, Government of India, New Delhi.

Government of Punjab. 1986. 'Report of the Expert Committee on Diversification of Agriculture in Punjab'. (Johl Committee Report), Government of Punjab, Chandigarh.

——. 2002. 'Expert Committee Report on Agricultural Production Pattern Adjustment Programme in Punjab for Productivity and Growth'. (Johl Committee Report), Government of Punjab, Chandigarh.

——. 2004. Budget Speech for the year 2003–04, Finance Minister of Punjab, available at http://www.punjabgov.net, accessed May 10.

——. 2005. 'Report of the Expert Committee on the World Trade Organization for Punjab'. (Alagh Committee Report), Government of Punjab, Chandigarh.

——. 2006a. *Annual Plan 2005–06*. Department of Planning, Government of Punjab, http://punjabgovt.nic.in/ECONOMY/AnnualPlan.htm, Accessed May 4, 2006.

——. 2006b. Department of Food and Supplies, Government of Punjab, http://punjabgovt.nic.in/GOVERNMENT/GOVT75M.HTM#PROCUREMENT, Accessed June 6, 2006.

——. 2006c. *Agriculture and Rural Development of Punjab: Transforming from Crisis to Growth*. Punjab State Farmers' Commission, Ludhiana, Punjab.

——. Various years. *Statistical Abstract of Punjab*. Office the Statistical Adviser, Economic and Statistical Organisation, Government of Punjab, Chandigarh.

——. 'Irrigation Water Quality'. Department of Soil and Water Conservation, Government of Punjab, http://dswcpunjab.gov.in/contents/map_gallery_1.htm.

Gulati, A. 1989. 'Input Subsidies in Indian Agriculture: A State-wise Analysis', *Economic and Political Weekly*. Review of Agriculture, Vol. 24, No. 25, June 24.

—— 1999. 'Pricing for Power and Water for Irrigation: Issues Related to Efficiency and Sustainability'. Mimeo., November.

Gulati, A., J. Hanson and G. Pursell. 1990. 'Effective Incentives in India's Agriculture'. Policy Planning and Research Working Paper No. 332 (Trade Policy), World Bank, Washington, D.C.

Gulati, A. and K. Kahkonen. 1996. 'The Food Corporation of India: Successes and Failures in Indian Foodgrain Marketing'. Mimeo., collaborative project of the National Council for Applied Economic Research (NCAER), New Delhi and the Centre for Institutional Reform and the Informal Sector (IRIS), University of Maryland, Washington, D.C.

Gulati, A. and K. Mullen. 2003. 'Responding to Policy Reform: Indian Agriculture in the 1990s and After'. Stanford Center for International Development Working Paper No. 1989, Stanford University

Gulati, A. and S. Narayanan. 2003. *The Subsidy Syndrome in Indian Agriculture*. Oxford University Press, New Delhi.

Hira, G. S., P. K. Gupta and A. S. Josan. 1998. 'Water Logging: Causes and Remedial Measure in South West Punjab', Research Bulletin No.1/98, Department of Soils, Punjab Agricultural University, Ludhiana.

Indian Council of Agricultural Research. 2001. *Annual Report 2000–01*. Indian Agricultural Statistics Research Institute, New Delhi.

Indiastat. www.Indiastat.com (an online data source on India)

Investment Information and Credit Rating Agency of India (ICRA) and Credit Rating Information Services of India Limited (CRISIL). 2005. 'Power Sector Rating: Consolidated Report to the Ministry of Power'. New Delhi, March.

Jha, S. and P. V. Srinivasan. 2004. 'Achieving Food Security in a Cost Effective Way: Implications of Domestic Deregulation and Reform under Liberalized Trade'. MTID Discussion Paper No. 67, International Food Policy Research Institute, Washington, D.C.

Johl, S. S. and S. K. Ray (eds). 2002. *Future of Agriculture in Punjab*. Centre for Research in Rural and Industrial Development, Chandigarh, India.

Kaur, R. 2003. Rationalization of Input Subsidies in Punjab, India. Unpublished manuscript, International Food Policy Research Institute, Washington, D.C.

——. 2004. Foodgrain Management: State and Private Sector in India, with reference to Punjab. Unpublished manuscript, International Food Policy Research Institute Washington, D.C.

Klein, B. 1996. 'Why Hold-ups Occur: The Self-enforcing Range of Contractual Relationships'. *Economic Inquiry*. Vol. 34, No. 3, pp. 444–63.

Kumar, A. Ganesh, Ashok Gulati and Ralph Cummings Jr. 2007. 'Foodgrains Policy and Management in India: Responding to Today's Challenges and Opportunities'. Unpublished manuscript, International Food Policy Research Institute, New Delhi.

Kumar, P. 2002. 'Economic Analysis of Total Factor Productivity of Crop Sector in the Indo-Gangetic Plain of India by District and Region'. Agricultural Economics, Research Report 2002 (2), Division of Agricultural Economics, Indian Agricultural Research Institute, New Delhi, India.

Kumar, P. and S. Mittal. 2003. 'Productivity and Supply of Foodgrains'. in S. M. Dev, K. P. Kannan and N. Ramachandran (eds), *Towards a Food Secure India: Issues and Policies*. Institute for Human Development, New Delhi.

Kumar, P. and Mruthyunjaya. 2002. 'Long Term Changes in Food Basket in India'. Paper presented at the Workshop on 'Agricultural Diversification in South Asia' organized by International Food Policy Research Institute in collaboration with the Royal Government of Bhutan, Ministry of Agriculture and the National Center for Agricultural Economics and Policy Research (NCAP), Paro, November 2002.

Mehta, Rajesh. 2005. 'Rationalization of Fertilizer Subsidy in Indian Agriculture: A Case of Urea Manufacture'. Mimeo., International Food Policy Research Institute, New Delhi.

Mullen, Kathleen, David Orden and Ashok Gulati. 2005. 'Agricultural Policies in India: Producer Support Estimates 1985–2002'. MTID Discussion Paper No. 82, International Food Policy Research Institute, Washington, D.C.

NCAER. 2003. 'Report of the Expert Group on Power Reforms in Punjab'. Mimeo, National Council of Applied Economic Research, New Delhi.

NSSO. 1978. '32nd Round Consumer Expenditure Survey: Schedule 1.0'. National Sample Survey Organization, Ministry of Statistics and Programme Implementation, Government of India, New Delhi.

——. 2000. 'Household Consumer Expenditure in India 1999–2000: Key Results'. Report No. 454 (55/1.0/2), National Sample Survey Organisation, Ministry of Statistics and Programme Implementation, Government of India, New Delhi.

——. 2003. '59th Round Consumer Expenditure Survey: Schedule 1.0', National Sample Survey Organization, Ministry of Statistics and Programme Implementation, Government of India, New Delhi.

——. 2004. '60th Round Consumer Expenditure Survey: Schedule 1.0', National Sample Survey Organization, Ministry of Statistics and Programme Implementation, Government of India, New Delhi.

——. 2006. 'Level and Pattern of Consumer Expenditure, 2004–2005'. Report No. 508 (61/1.0/1), National Sample Survey Organisation, Ministry of Statistics and Programme Implementation, Government of India.

Puri, J. 1996. 'An Analysis of the Wheat and Rice Markets in India: Background Working Paper'. Mimeo.,World Bank, Washington, D.C.

Radhakrishna, R. and K. Subbarao. 1997. 'India's Public Distribution System: A National and International Perspective'. The World Bank Discussion Paper No. 380, Washington D.C.

Rashid, S., R Cummings, Jr. and A. Gulati. 2005. 'Grain Marketing Parastatals in Asia: Why Do They Have to Change Now'. MTID Discussion Paper No. 80, International Food Policy Research Institute, Washington, D.C.

Rashid, S., S. Mahendra Dev, M. Thomas and A. Gulati. 2005. Reforming Food Price Policies in India: Rationales and Distributional Effects. Unpublished manuscript, International Food Policy Research Institute, Washington, D.C.

Reimer, J. J. 2006. 'Vertical Integration in the Pork Industry'. *American Journal of Agricultural Economics*. Vol. 88, No. 1, pp. 234–48.

Reserve Bank of India (RBI). 2001. *State Finances: A Study of Budgets of 2000–01*. Reserve Bank of India, Mumbai.

——. 2002a. *State Finances: A Study of Budgets of 2001–02*. Reserve Bank of India, Mumbai.

——. 2002b *Handbook of Statistics on Indian Economy*. Reserve Bank of India, Mumbai, available at www.rbi.org.in.

Sehgal, Rashme. 2005. 'Contract Farming in the Punjab'. *Infochange India News and Features*, June. Available at www.infochangeindia.org/features282.jsp.

Sidhu, R. S. and A. S. Bhullar. 2004. 'Changing Structure of the Farm Economy in Punjab: Impact of Livestock on Income and Employment'. *Indian Journal of Agricultural Economics*. Vol. 59, No. 3, pp. 578–87.

Sidhu, R. S. and Sukhpal Singh. 2004. 'Agricultural Wages and Employment in Punjab'. *Economic and Political Weekly*, Vol. 39, No. 37, September 11, pp. 4132–4135.

Sidhu, R. S., P. G. Chengappa, D. Dhankhar and K. M. Rich. 2006. 'Agricultural Diversification in the Punjab: Trends, Constraints, and Policy Options'. Unpublished manuscript, International Food Policy Research Institute, New Delhi.

Singh, Perneet. 2006. 'A fruitful alternative to wheat–paddy cycle: Citrus & agri juicing council shows way'. *The Tribune*, Chandigarh, October 9, available at http://www.tribuneindia.com/2006/20061009/punjab2.htm#8.

Singh, J. and H. S. Dhaliwal. 2002. 'Economic Analysis of Farm Enterprises in Punjab', in S. S. Johl and S. K. Ray (eds), *Future of Agriculture in Punjab*, Center for Research in Rural and Industrial Development, pp. 40–55.

Singh, J. and M. Hossain. 2002. 'Total Factor Productivity Analysis and its Components in a High Potential Rice–Wheat System: A Case Study of the Indian Punjab'. In M. Sombilla, M. Hossain and B. Hardy (eds), *Developments*

in the Asian Rice Economy, International Rice Research Institute, Los Banos, Philippines.

Singh, K. and S. S. Chahal. 2001. 'Marketing Structure and Performance for Vegetables in Punjab', in Jagdish Prasad (ed.), *Encyclopedia of Agricultural Marketing*, Vol. 8.

Singh, K., P. S. Rangi and S. Kalra. 2004. 'Wheat Production and Sustainability in Punjab: Growth and Varietal Diversity'. *Indian Journal of Agricultural Economics*. Vol. 59, No. 4, October–December.

Singh, Sangeeta. 2005. 'The next green revolution'. *Business Standard*, New Delhi, October 22.

Singh, Shalini. 2007. '200m phones and growing', *The Times of India*, New Delhi, February 18.

Singh, V. K. and B. S. Dwivedi. 2006. 'Yield and Nitrogen Use Efficiency in Wheat, and Soil Fetrility Status as influenced by Substitution of Rice with Pigeon Pea in Rice–Wheat Cropping Systems'. *Australian Journal of Experimental Agriculture*, Vol. 46, No. 9, pp. 1185–94

Svendsen, Mark, A. Gulati and K. V. Raju. 2005. 'Financial and Institutional Reforms in Indian Canal Irrigation'. Unpublished manuscript, International Food Policy Research Institute, Washington, D.C.

The Economist. 'Can Indian fly?', June, 3.

The Fertiliser Association of India. 2005. *Fertiliser Statistics 2004–05*. The Fertiliser Association of India, New Delhi.

The Tribune. 2006. 'Projects announced by PM'. Chandigarh, December 21, available at http://www.tribuneindia.com/2006/20061221/main5.htm.

USDA–FAS. Various years. *India: Grain and Products Annual*. U.S. Department of Agriculture, Foreign Agricultural Service, Washington, D.C.

Vashishtha Prem S. 2003. 'Tail Enders and Other Deprived in an Irrigation System in Haryana', Research Study No. 2003/1, Agricultural Economics Research Centre, University of Delhi, Delhi.

——. 2005. 'Fertilizer Subsidy in Indian Agriculture'. Unpublished manuscript, International Food Policy Research Institute, New Delhi.

Vashishtha, Prem S. and K. Gupta. 2006. 'Input Subsidy in Punjab Agriculture'. Unpublished manuscript, International Food Policy Research Institute, New Delhi.

Veeraiah, C. and N. Madankumar. 1994. 'Waste of Irrigation Water Under Major Irrigation Projects in Andhra Pradesh and its Prevention'. Paper presented at the Seminar on 'Wastages of Irrigation Water under Major Irrigation Projects', Si Venkateswara University, Tirupati, September.

Williamson, O. 1989. 'Transaction Cost Economics', in R. Schmalensee and R. D. Willig (eds), *Handbook of Industrial Organization, Volume I*. Elsevier Science Publishers B.V., Amsterdam, pp. 136–82.

World Bank. 1999. 'India: Foodgrain Marketing Policies: Reforming to Meet Food Security Needs'. Report No. 18329-IN, Rural Development Unit, South Asia Region, Washington, D.C.

——. 2003a. 'Why are Power Sector Reforms Important for the Poor?' World Bank, New Delhi.

——. 2003b. 'The Incidence of Canal Irrigation Subsidies in India: A Policy Note'. Rural Development Unit, South Asia Region, Washington, D.C.

——. 2003c. 'India: Revitalizing Punjab's Agriculture'. Unpublished Report, Rural Development Unit, South Asia Region, Washington, D.C.

——. 2004. *World Development Indicators*. World Bank, Washington, D.C.

——. 2005. *India: Re-energizing the Agricultural Sector to Sustain Growth and Reduce Poverty*. Oxford University Press, New Delhi.