



Resource Efficiency in Food Chains

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Presentation Tour



- **Punjab Agriculture: Contribution**
- **Green Revolution and Present situation**
- **Resource Utilization in food Supply Chain**
- **Major Issues**
- **Way Forward**
- **Case Studies**

Punjab Agriculture: Contribution



- **Geographical area: 5.03 m ha; Net sown area: 4.2 m ha (83.5%)**
- **Punjab with 1.53% of India's geographic area produces about 19 % of wheat, 10% % of rice, and 5% of cotton**
- **Contributes about 23.6 % of the State's GDP (crops 15.3% + live stock 8.3%) (17% at national level)**
- **Number 1 contributor to central food grain pool**
 - up to 78% of wheat, 1968-69 (75% in 2005-06)
 - up to 59% of rice, 1979-80

Punjab Agriculture: Contribution



- State produces 2% of rice, 3 % of wheat and 1% cotton of the world.
- Provides livelihood to 50-55% of rural population
- State has the highest irrigated area (99.9%) and the highest cropping intensity (204%).
- State surpassed all previous records in wheat production during *Rabi (Winter)* 2011-12 and rice production in *Kharif (Summer)* 2017-18.

Green Revolution



- William S. Gaud, Administrator of the USAID, first used the term 'Green Revolution' in his speech (1968) "The Green Revolution: Accomplishments and Apprehensions" on March 8, 1968.
- The term 'Green Revolution' refers to a phenomenal increase in food production (mainly wheat and rice) during late 1960's in certain regions of the world especially South East Asia.

Green Revolution: Looking at Past



A spectacular increase in production of wheat and rice during 1960s and 1970s in Punjab

Crop	Year	Yield (q/ha)	Production (M. ton)
Wheat	1960-61	12.4	1.77
	1970-71	22.4	5.14
Paddy	1960-61	15.5	0.35
	1970-71	27.7	1.03

Green Revolution: Main Factors



- New technologies
- Fertilizers
- Tubewell irrigation
- MSP and Procurement
- Roads and markets
- Credit

Rice followed Wheat in 1970s



- Improved rice varieties - IR 8 (1968), Jaya (1971), PR 106 (1976)
- IR 8 seed obtained for planting in 400 ha (1969)
- 100 per cent rural electrification in Punjab inaugurated by Smt. Indira Gandhi, then PM on 31.5.1976 that paved the way for promotion of rice cultivation in the state
- Land reclamation (6 lac ha in 1970) helped in area expansion under rice



ISSUE : Water Use

- Punjab neither ecologically suited nor consumer of rice
- Rice cultivation promoted by National Policy to meet food security needs
- MSP (Rs/Kg) : Paddy (0.52) vs wheat (0.76) during 1967-68
Paddy (15.50) vs wheat (17.35) during 2017-18
- Free electricity supply to tubewells
- **Area under rice expanded quickly**



WHY ??????

Famine - 1975!

William Paddock and Paul Paddock (1968)



For use of American Food, the authors classified the under-developed nations as follows:

Country	Opinion
Haiti	Can't be saved
Egypt	Can't be saved
India	Can't be saved
Tunisia	Should receive food
Pakistan	Should receive food
The Gambia	Walking wounded
Libya	Walking wounded

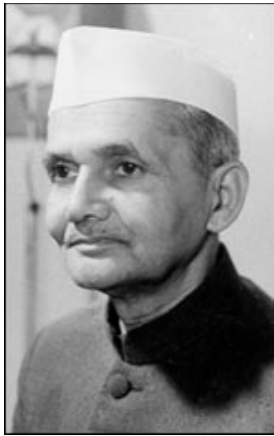
The Tribune

ESTABLISHED 1881

Largest Circulation in North-West India
Ambala, Punjab, November 2, 1965



The Tribune
2 November 1965



- Lal Bahadur Shastri, then Prime Minister, gave an appeal in 1965 to miss one meal on all Mondays
- All hotels, restaurants, road-side eateries were appealed to close down on Monday nights. Even state dinners were banned on Mondays. Was known as “Shastri Vrat”.

Miss-A-Meal Campaign In Punjab

From Our Correspondents

AMRITSAR, Nov. 2.—In response to the Prime Minister's appeal, nearly 50 per cent of the adult citizens of Amritsar numbering about one lakh missed the midday meal yesterday. No food was served in many restaurants, dhabas and lodges. The Dhabba and Tandoor Union has decided not to serve one meal every Monday.

Mr. T. N. Singh, Union Minister for Industry, who was here on tour, decided to forego his lunch although he had been specially invited by a leading mill-owner. Government officials, school teachers and grown-up school and college students also missed their midday meal.

LUDHIANA: The first Monday of the miss-a-meal campaign met with an encouraging response in Ludhiana. A large number of families in the city did not take cereals in their meals.

The 729 inmates of the Ludhiana Jail have been missing a meal every week since October 7. Thus they have been saving 62 kilos of cereals every week.

MOGA: Five thousands and five hundred Government teachers of the border district of Ferozepur have taken a pledge to miss a meal every week.

Addressing a students' meeting yesterday, Mr. Bhag Singh, President of the Government Teachers Union of this district, called upon

the teachers to be prepared for any sacrifice that they might have to make for the defence of their country.

PATIALA: The staff of the Electrical Inspectorate of the Punjab State has resolved to miss a meal on every Monday. Mr. M. L. Sachdeva, Chief Electrical Inspector, presided over the meeting at which the decision was taken.

SONEPAT: The miss-a-meal campaign got off to an encouraging start yesterday when thousands of people in the Sonapat tehsil went without a meal.

IT WASN'T A PATTON

From Our Correspondent

AMBALA, Nov. 2.—A rumour that a Pakistani Patton tank captured by the Jawans was in the Ambala Cantonment railway yard, sent thousands of people rushing to the railway station to have a look at the war trophy yesterday.

But ultimately it turned out that the object of their curiosity was not a Patton tank but an observer carrier, on its way to Delhi.

Steady Flow

Govt. Appeal in Preetlari - 1966



ਹਰ
ਤੀਸਰਾ
ਫੁਲਕਾ
ਜੋ ਤੁਸੀਂ
ਖਾਂਦੇ ਹੋ



ਬ ਦੇ ਸ਼ੀ ਕ ਲ ਕ
ਦਾ
ਬਣਦਾ
ਹੈ



ਅਸੀਂ ਇਸ ਨੂੰ ਨਾ ਖਾਈਏ

ਅਨਾਜ ਬਚਾਓ



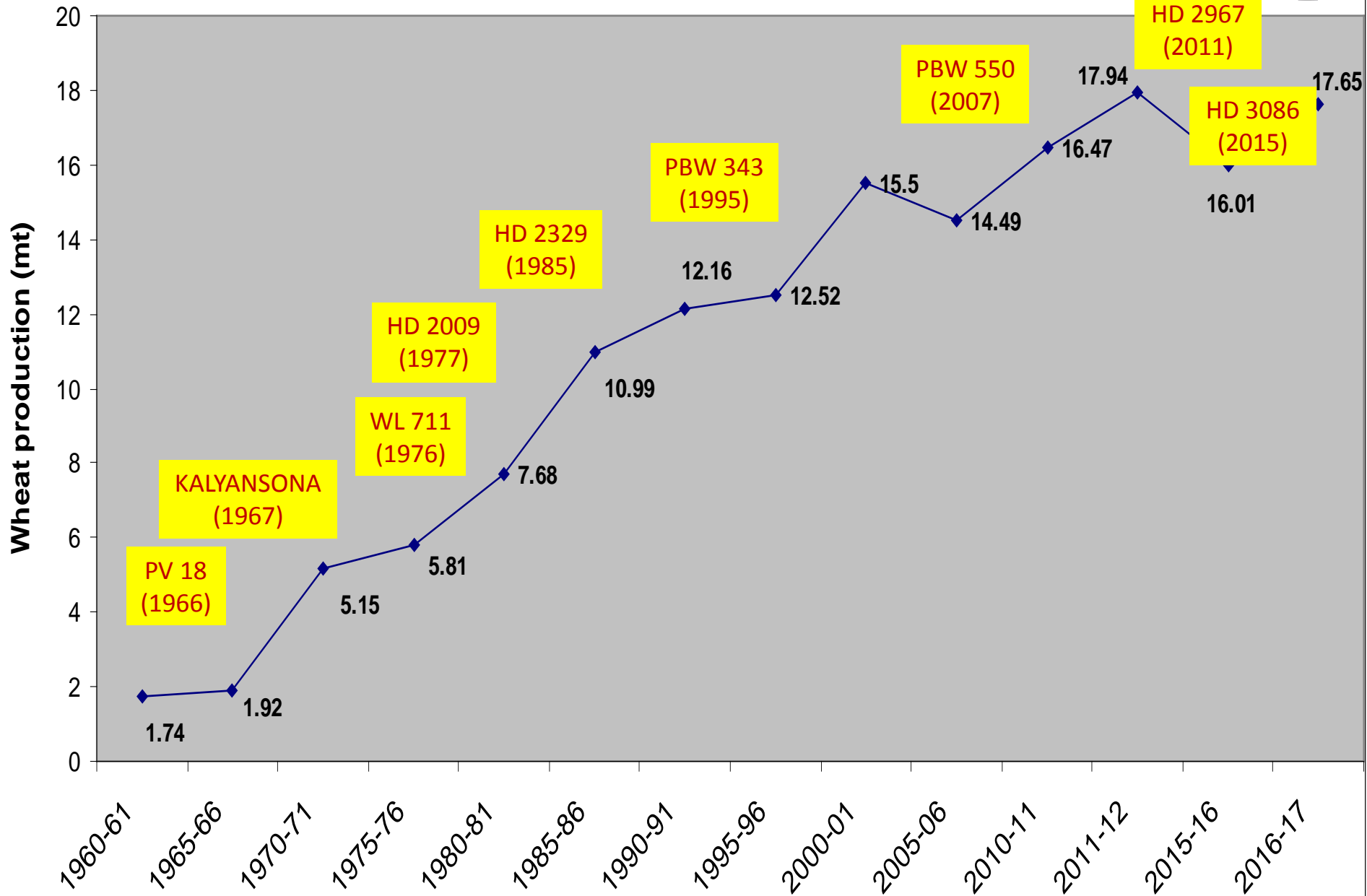
ਇਸ ਤੋਂ
ਬਦੇਸ਼ੀ ਮੁਦਰਾ
ਬਚੋਗੀ

DA 61/79

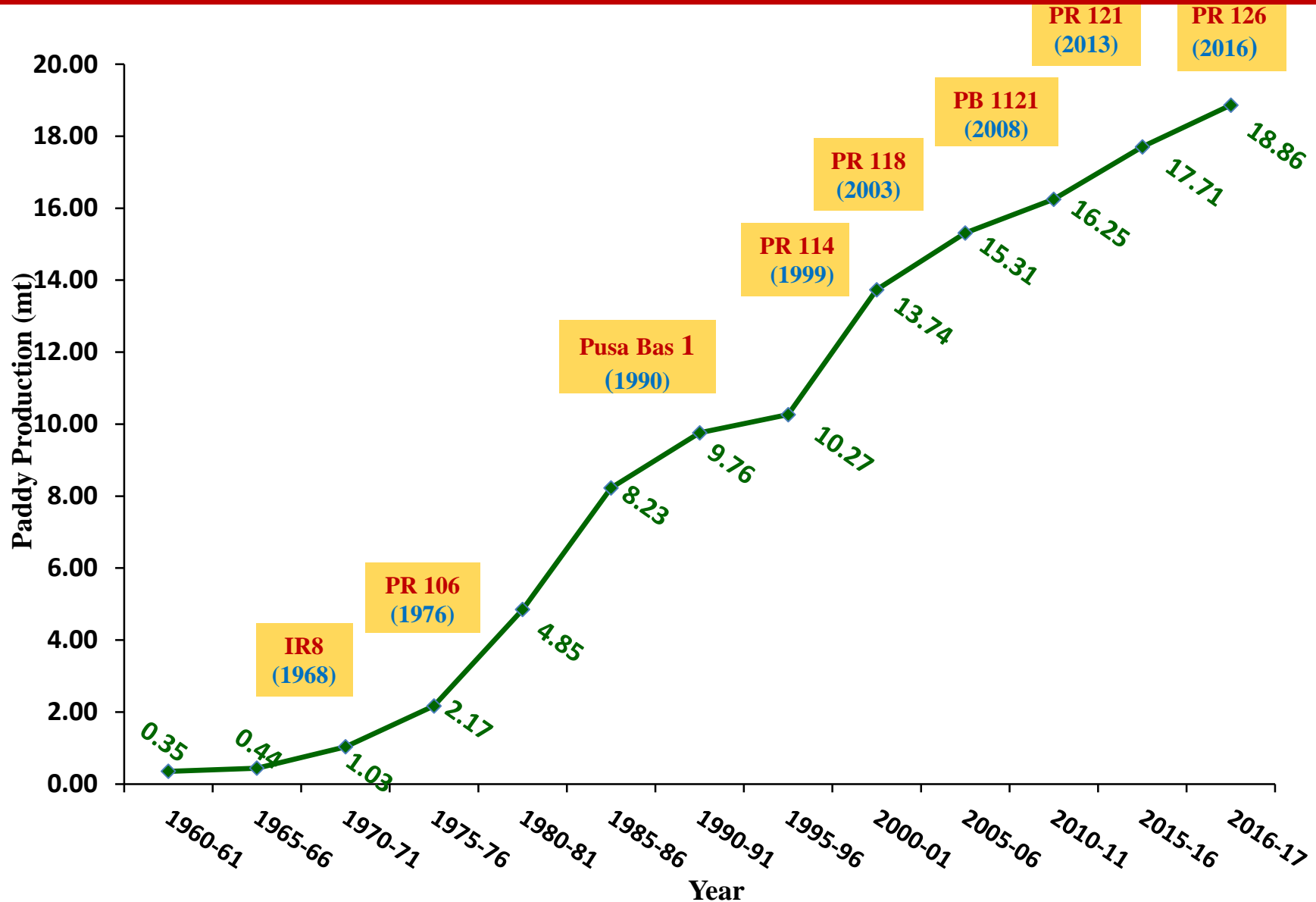
ਫਰਵਰੀ 1966 ਦੇ ਪ੍ਰੀਤਲੜੀ ਮੈਗਜ਼ੀਨ 'ਚ ਛਪਿਆ ਇਸਤਿਹਾਰ



Impact of varieties on wheat production in Puniab



Impact of varieties on Paddy Production (Punjab)



Present Scenario



Punjab followed intensive agriculture to meet National Food Security Needs

Year	Food grain production (Million tons)	Cropping intensity (%)	Irrigated area (%)	Fertilizer use (N+P+K) (kg/crop ha)	Insecticide/ Pesticide use (tons of Tech. grade)	Number of tractors ('000)
1960-61	3.2	126	54	1	NA	NA
1970-71	7.3	140	71	38	NA	53
1980-81	11.9	161	93	113	3200	119

2010-11	27.8	190	98	243	5600	504
2016-17	30.7	204	99***	247*	5721*	472**

*2015-16; ** 2014-15; *** 14 lakh tube wells of which 12.3 lakh electric

Punjab is the Leader in Agriculture



Highest Productivity

Wheat + Paddy: 11.60 t/ha (2017-18)

Dependence on Punjab Increases when National Foodgrain Production Falls

Year	National Foodgrain production Million t	Share of Punjab in wheat (%)	Share of Punjab in rice (%)
2003-04	213	55	38
2004-05	198	61	37
2005-06	209	75	32
2008-09	234	38	26
2009-10	218	43	35



Footprints of Green Revolution

- **Water**
 - Depletion of ground water
 - Adverse effect on water quality
- **Soil health**
 - Mining of nutrients and their export
 - From FYM to chemical fertilizers
 - Development of hard pan
- **Pesticides and Electricity**
 - Over use
- **Mechanization**
 - Under use of tractors
- **Environment**
 - Burning of crop residue
 - Overuse of agro-chemicals

Yield (q/ha, 2016-17)	Wheat	Paddy
Punjab	50	62
India	32	38

Resources

RESOURCE UTILIZATION

ISSUE: Water Table Decline in Punjab is a Reality



Research Based Enactment of **Preservation of Sub-soil Water Ordinance Punjab (2008)** (Paddy transplantation to start after June 10/15)

Period	Average decline (cm/year)	Average Rainfall (cm)	Area under Paddy (Million Ha)	Total Tube wells (Million)
June 1990- June 2000	25	64 *	2.25	0.92
June 2000- June 2008	84	39	2.61	1.15
June 2008- June 2014	50	53	2.73	1.33
June 2014- June 2017	60	50	2.97	1.41

*1990-2000 More rainfall, 2000-2008 Less rainfall
2008-2014 Preservation of Sub-Soil Ordinance Punjab
2014-2017 Increase in paddy area

Water Resources of Punjab

Source	Water Available (M ha m)
Canal water (Head Works)	1.79
Canal water (Outlet)	1.45
Groundwater	2.34
Annual available water	3.79
Annual water demand	4.41
Deficit	0.62

NPK Use in Punjab



Year	Use (kg/ ha)
2000-01	169
2005-06	214
2010-11	243
2011-12	243
2012-13	251
2013-14	218
2014-15	213
2015-16	247

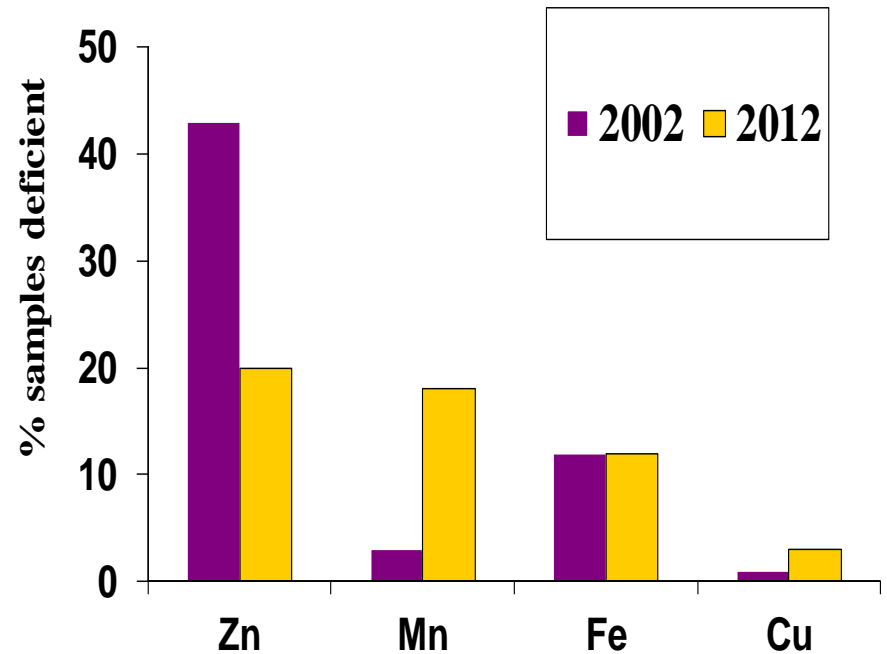
- High yield
- 60-70% of wheat and rice exported out of state
- Burning of residues

Intensive agriculture uses high level of nutrients



Besides Overuse of NPK

- Deficiency of micro-nutrients
 - Zinc (20%)
 - Manganese (18%)
 - Iron (12%), etc
- Solution: Practice INM
 - FYM
 - Compost
 - Green manuring
 - Biofertilizers
 - Crop residue incorporation
- Soil Test based N application
- Leaf Colour Chart (rice, wheat, maize)



Constraint:

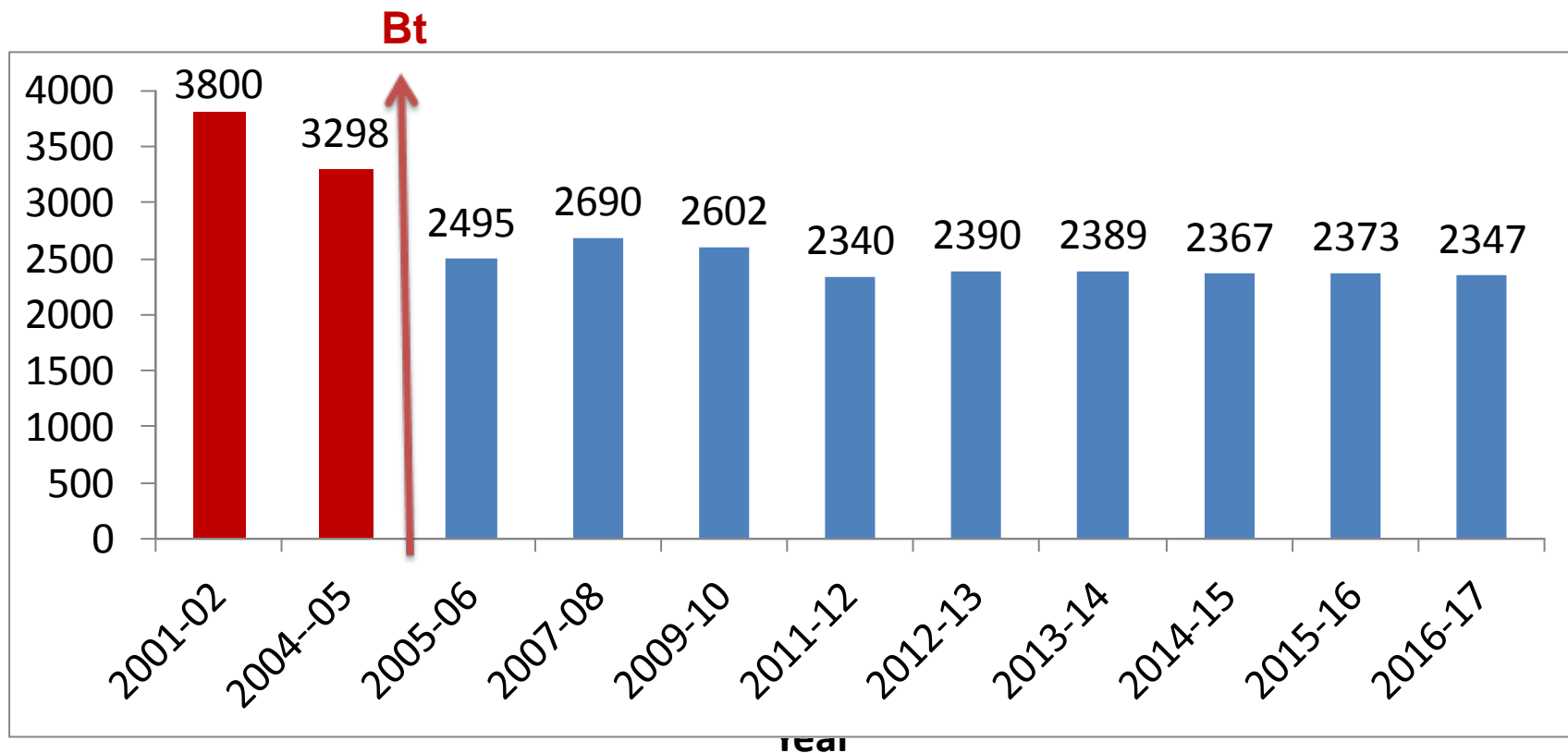
Farmers compete for yield rather than profit

Consumption of Insecticides (tons) in Punjab



Integrated Pest Management

- IPM in cotton (1978), Sugarcane (1998), Maize (2008) Basmati (2009)
- Bio-control: *Trichogramma*, *Trichoderma*





Crop Productivity

Years	Average productivity (q/ha)				
	Wheat	Paddy	Maize	Cotton (lint)	Sugarcane
1960-61	12.4	15.5	11.4	2.7	365
2001-02 to 2010-11	43.5	57.4	30.3	6.3	596
2011-12 to 2017-18	48.4	60.0	37.8	5.6 (6.2)*	757

* Excluding 2015-16

Recent gluts: Basmati, Potato, Pea, Carrot, Cauliflower

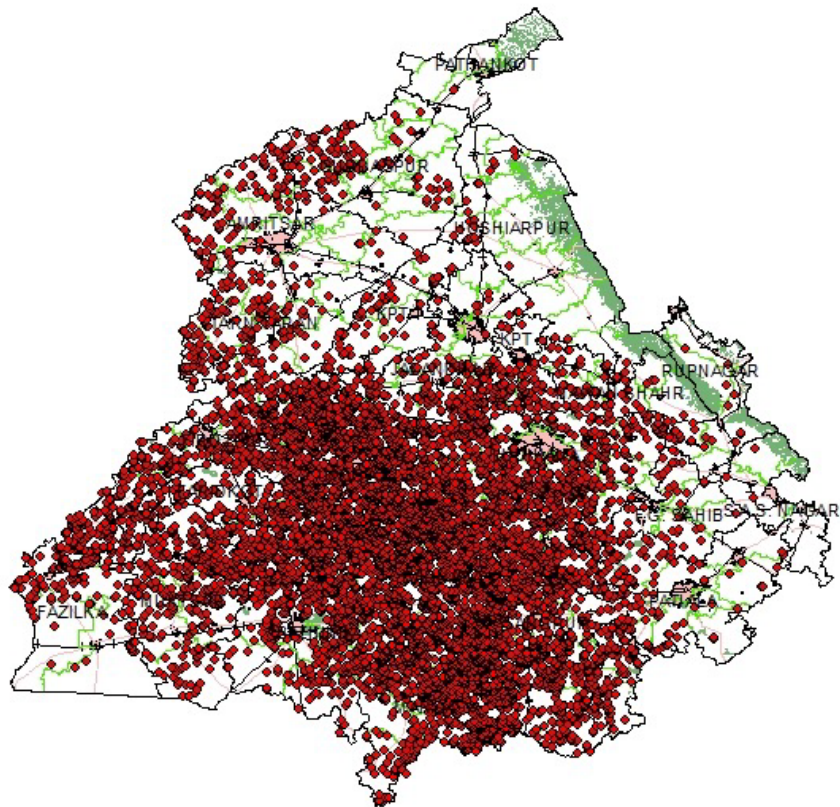


Major Issues facing Punjab

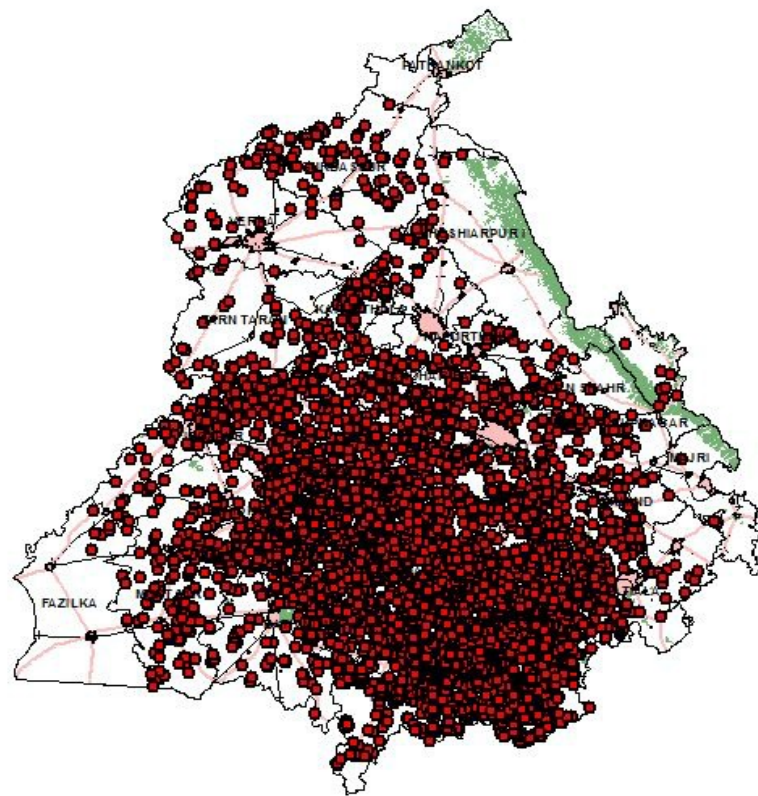
PUNJAB SCENARIO

Area under paddy	≈ 3.0 M ha
Paddy straw produced	≈ 20 MT
Burnt	≈ 85 %

VIIRS (Visible Infrared Imaging Radiometer Suite) – Spatial Resolution 375 m



Active fire locations detected in Punjab on 7 November 2016



Active fire locations detected in Punjab on 4 November 2017

Straw Burning



Straw Burning



PADDY STRAW BURNING: Why?

1. Paddy harvesting leaves 6-7 ton straw per ha and is **surplus**
2. It is a low density stuff
3. Next crop, mainly wheat is to be planted in 20-25 days
4. No time for Potato and other vegetable crops
5. Handling 7 ton/ha, needs equipment (capital), additional energy (money) and time

EFFECTS OF PADDY STRAW BURNING/REMOVAL

NUTRIENT LOSS	Kg/ton	Kg/ha
➤ Nitrogen :	5.5	33.0
➤ Phosphorus (partial in burning) :	2.3	13.8
➤ Potash (Negligible in burning) :	25.0	150
➤ Sulfur :	1.2	7.2
➤ Micronutrients :	10-20	60-120
➤ Soil organic carbon :	400	2400

- ✓ **Deterioration of soil physical health**
- ✓ **Health hazards and accidents**
- ✓ **Air pollution and green houses gases**
- ✓ **Loss of micro-biodiversity**

Crop Residue Management



Total paddy straw : 20 million t
Burning : 85 %



- Loss of nutrients and organic matter:
 - > 80% of C, N and S
 - Other nutrients are lost partially (10-20%)
- Loss of soil microbes
- Environmental pollution
- Health and other hazards

Options for straw management:

- Incorporation
- Mulches
- Removal
 - Bioenergy, Biogas, Mushroom, Card board , etc.
- ***In situ biodegradation***

Machinery for Paddy Straw Management



- **Happy Seeder**
- **PAU Super SMS**
- **PAU Straw Cutter – cum - Spreader**

PAU Happy Seeder



Wheat sown with Happy Seeder



Wheat sown with modified Happy Seeder

PAU Super SMS

For chopping and spreading of loose straw coming out of combine to facilitate operation of Happy Seeder



PAU Super SMS

PAU Straw Cutter- cum- Spreader

For chopping and spreading of loose straw and standing stubbles after combine harvesting to facilitate operation of Happy Seeder



PAU Straw Cutter cum Spreader



Climate Change

In Punjab, during the last 40 years:

- Minimum mean temperature increased by 1° C
- Relative humidity increased
- Rainy days decreased
- Green House Gases (CO₂, CH₄ and N₂O)

Effect of enhanced temperature

- Early flowering and maturity affecting yield
- Decline (5-7%) in wheat yield for every degree increase in temperature
- Horticultural crops requiring chilling will be affected
- Incidence of pests and diseases

Effect of enhanced carbon dioxide

- Will be beneficial in photosynthesis particularly for C₄ plants

Post Harvest Losses (National)

Sr. No	Crops	Wastage %
1.	Cereals	4.65- 5.99
2.	Pulses	6.36-8.41
3.	Oil seeds	3.08-9.96
4.	Fruits and Vegetables	4.58- 15.88
5.	Milk	0.92
6.	Fisheries	10.52
7.	Poultry Meat	6.74

Value of Food Products waste : £ 5 billion

Onion wastage = 1 million tonnes

Tomato wastage= 2.2 million tonnes

Infrastructure bottlenecks in Supply Chains

- Grains (State dominated)
 - Max 45 days to clear Wheat and Paddy from fields to storage places (Approx. 18 Mt each)
 - Old technology in storage
 - Inadequate storage facilities- open storage
 - Fortified Wheat- separate supply chain
- Fresh Fruits and Vegetables
 - Market places inadequate and inefficient
 - Cool Chains missing or inadequate
 - Product specific cold chains- Potato



Agrarian Crisis

Average Monthly Income of Agricultural Households, 2012-13

(Rs/ Household)

State	From agriculture	From other sources
Punjab	16349 (90.5%)	1710 (9.5%)
Haryana	10916 (75.6%)	3518 (24.4%)
Bihar	1904 (53.5%)	1654 (46.5%)
India	3350 (52.1%)	3076 (47.9%)

Source: NSSO, 2013

Income increasing, net profit decreasing

WAY FORWARD

Diversification



- **Punjab can sustain only 13.5 lakh ha paddy**
- Replacement of about 16 lakh ha to other crops
- **Diversification options:**

Maize, Cotton, Sugarcane, Pulses, Fruits and Vegetables, Fodder

Constraints:

- Less demand, high marketing risk, Less profitable
- High production risk, less mechanized
- Climate change

What is required: A Level Playing Field in terms of policy support:

- Remunerative prices
- Assured marketing for alternatives
- Demand creation
- Technology required
 - Productivity increase in maize, cotton, pulses, vegetables and fruits
- Value addition and processing
- Farm machinery
 - Maize planter and dryer, Sugarcane harvester, Cotton picker

Diversification is required for sustainability and may /may not enhance income

Diversification: Promotion of Horticulture



Area (in thousand ha)

Year	Vegetable	Fruits
2001-02	110	34
2011-12	180	69
2017-18	260	84

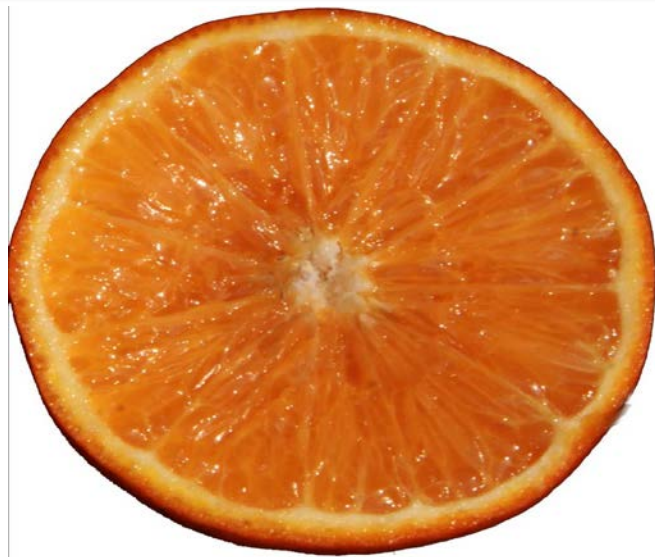
- Poly net-house for capsicum, tomato, brinjal, cucumber and papaya cultivation (High yield, increased availability span, better quality)
- PAU Less Seeded Kinnow (2015)
- Diversification in mandarins with the release of Daisy Tangerine and W. Murcott (2013)
- Promotion of Guava cultivation (Punjab Safeda, Punjab Kiran – 2018)



PAU Kinnow 1 (2015)



Character	PAU Kinnow 1	Kinnow
Seed number/ fruit	3	21
Range (bold seed No.)	0-9	12-36
TSS (%)	10.6	10.6
Acidity (%)	0.82	0.84
Juice content (%)	48.5	47.8



PAU Kinnow 1

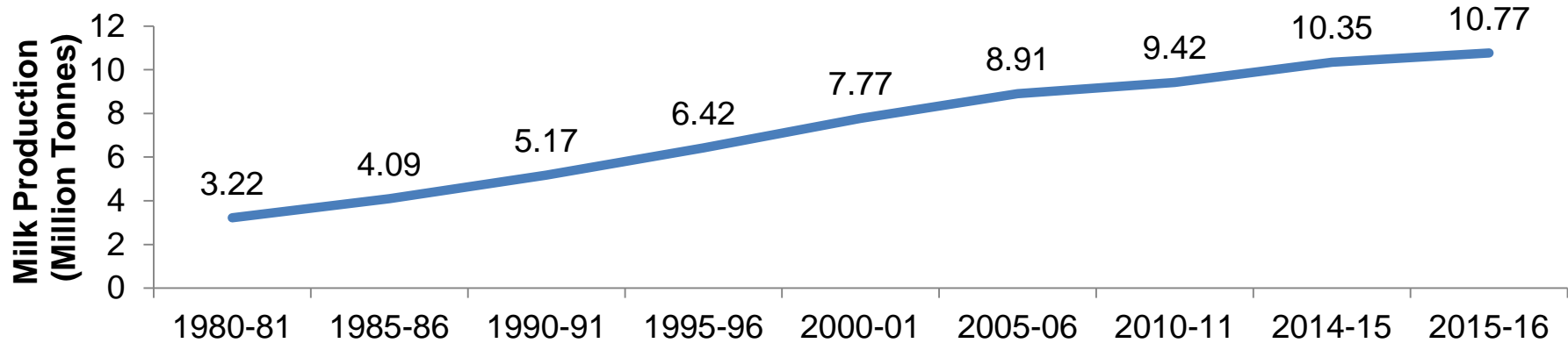


Kinnow

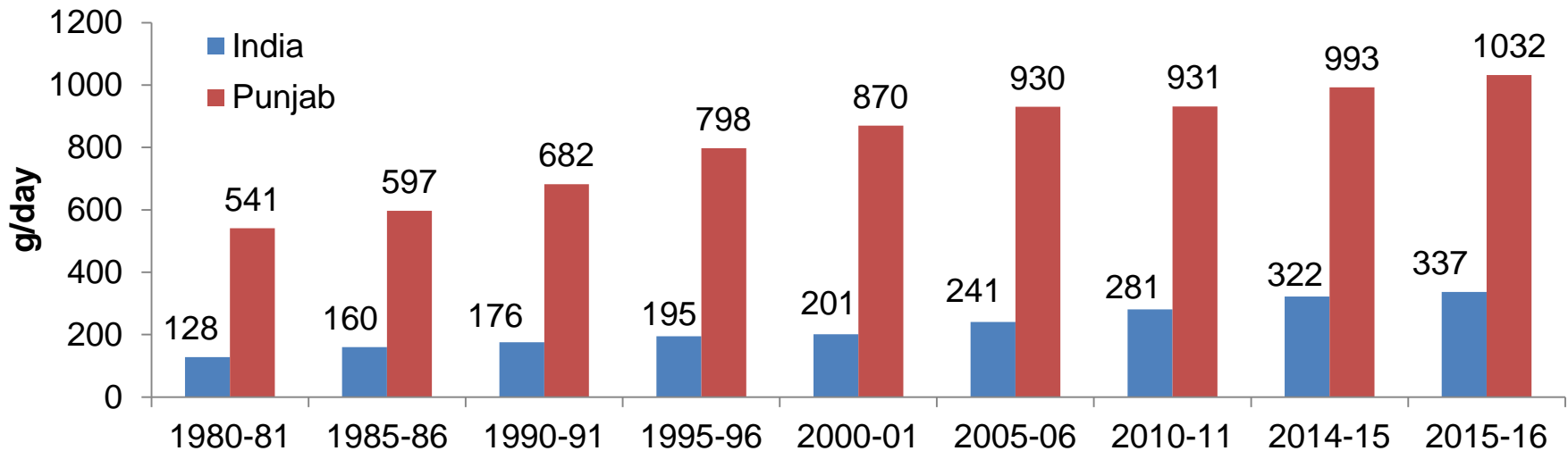
Dairy Farming – A Profitable Allied Occupation



Milk Production Trends in Punjab



Per Capita Availability of Milk (g/day)



Agro-processing Complexes



Small scale Agro-processing Complexes for value addition at village level generate employment for rural youth and make quality food material available locally.

Machines –

1. Mini rice mill
2. Mini Flour Mill
3. Baby oil expeller
4. Spices grinder
5. Cattle feed mill

Cost of the complex – Rupees 15 to 20 lakh
Profit per month – Rupees 50,000 to 80,000



Total number of such complexes working in Punjab – 295

Such complexes shall have to be Area Specific

TIGR2ESS

- Why?
- How ?

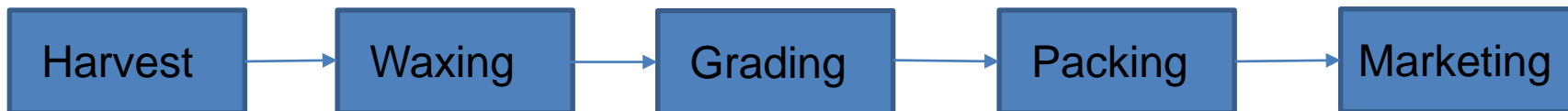
CASE STUDIES

Case Study

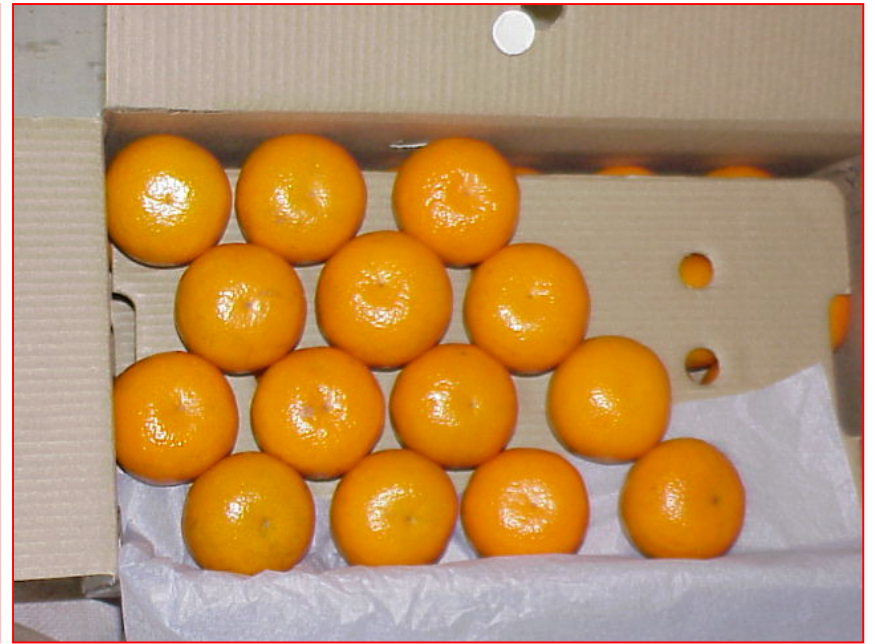
KINNOW

Kinnow

- Area : 60,000 ha
- Produce : 1 million tones
- Channel



Target : Exporting 20,000 tonnes of Kinnow to CIS and other countries through Reefer Chain(temperature 5-7 degree celcius)



Coating of Kinnow



Storage of Kinnow in commercial cold storage (5-6°C) at Kailash cold storage Ludhiana



Storage life 45 days at 5-7°C temperature and 90-95% RH.

Packaging for retail marketing



Shrink Film Packaging of kinnow Fruits



After 2 weeks of storage



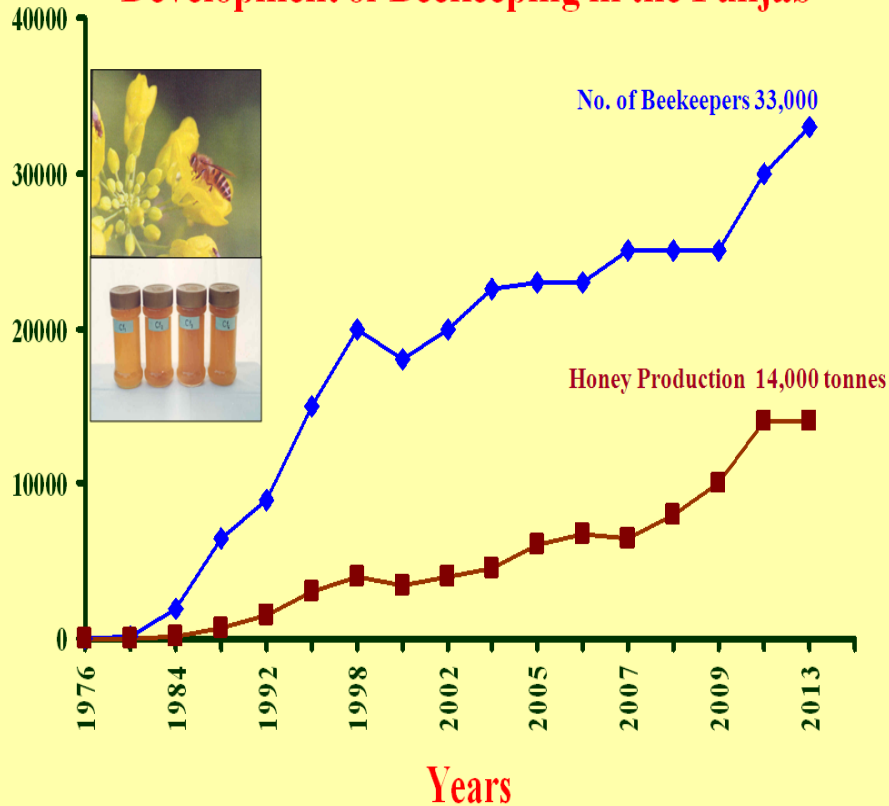
Case Study

HONEY PRODUCERS

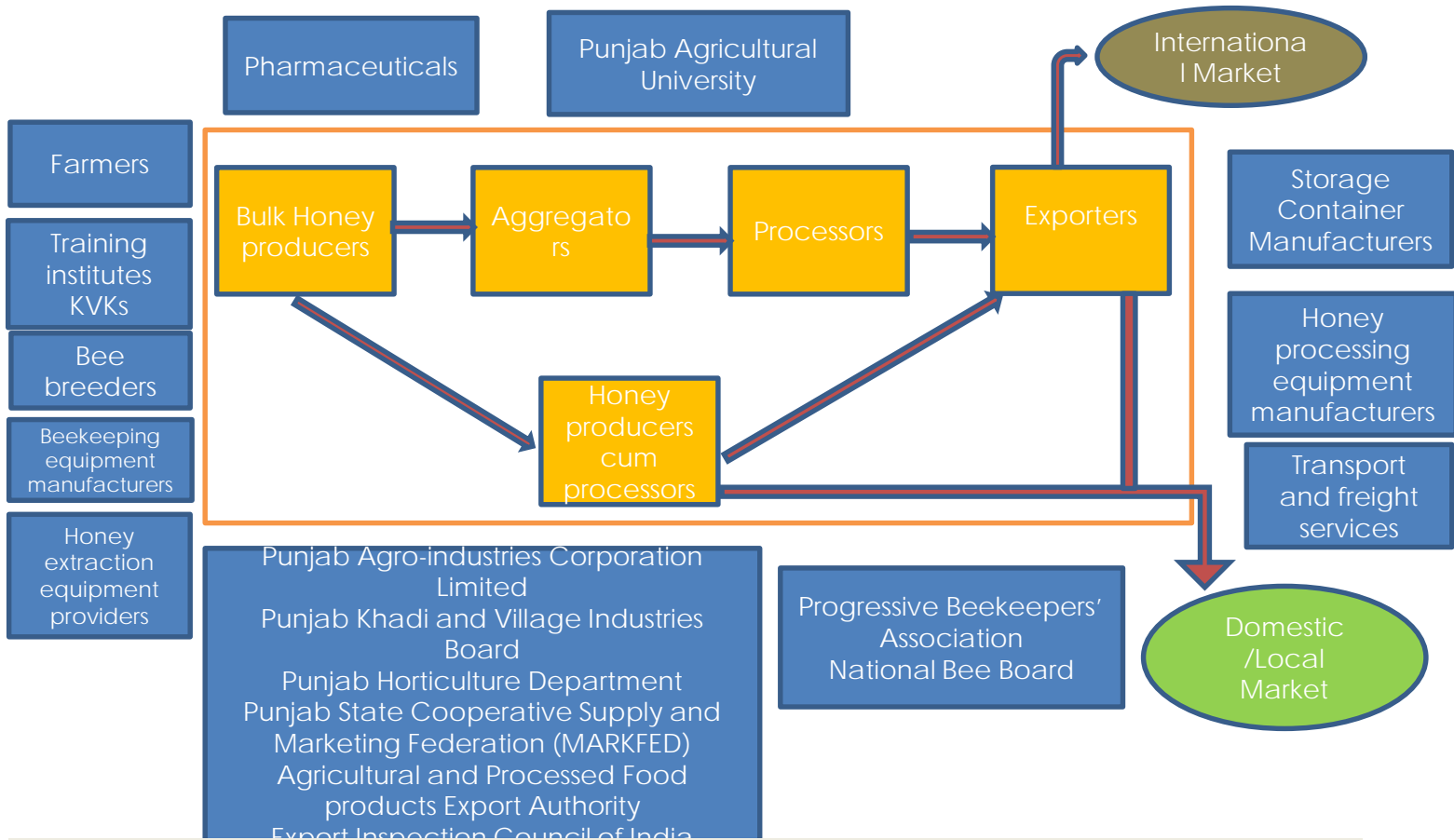
Bee-keeping in Punjab



Development of Beekeeping in the Punjab

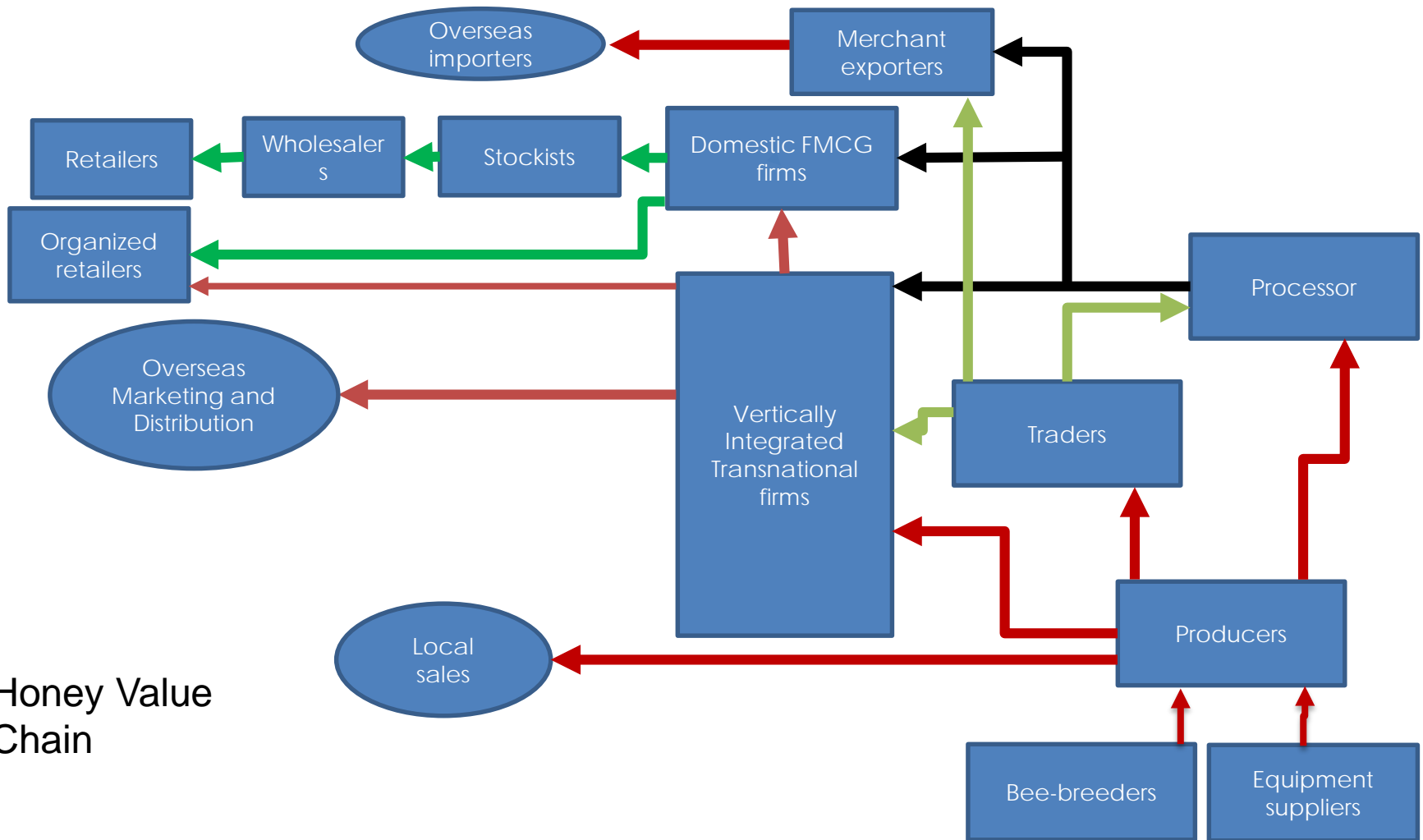


- Apiary size: 100 *Apis mellifera* colonies (35000 bee keepers)
- Estimated Profit
~ Rs. 3,20,000 per year



Stakeholder network map of the
beekeeping cluster

Honey Value Chain

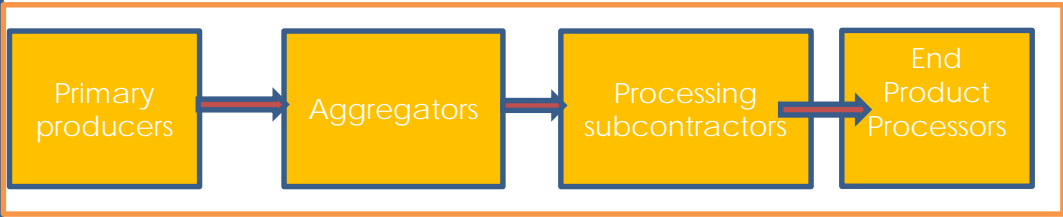


Case Study

***KANDI* FRUIT AND VEGETABLE CLUSTER**

Punjab Agro-industries Corporation Limited
 Punjab Khadi and Village Industries Board
 Punjab State Cooperative Supply and Marketing Federation (MARKFED)
 APEDA
 Export Inspection Council of India
 Department of Agriculture, Punjab
 PAGREXCO
 Department of Animal Husbandry, Dairy Development and Fisheries, Punjab
 Department of Soil Conservation, Punjab
 Department of Horticulture, Punjab
 Department of Forest and Wildlife Development
 PSCST PBTI
 Punjab Mandi Board
 Punjab Technical Education Department

Research and Development:
 Indian Institute of Sugarcane Research, Lucknow (IISR)
 Kelkar's Scientific Research Centre, Mumbai (KSRC)
 Punjab Agricultural University (PAU)
 Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana (GADVASU)
 Institute for Himalayan Bio-resources Technology, Palampur (IHBT)



Farmers' Associations

International Market

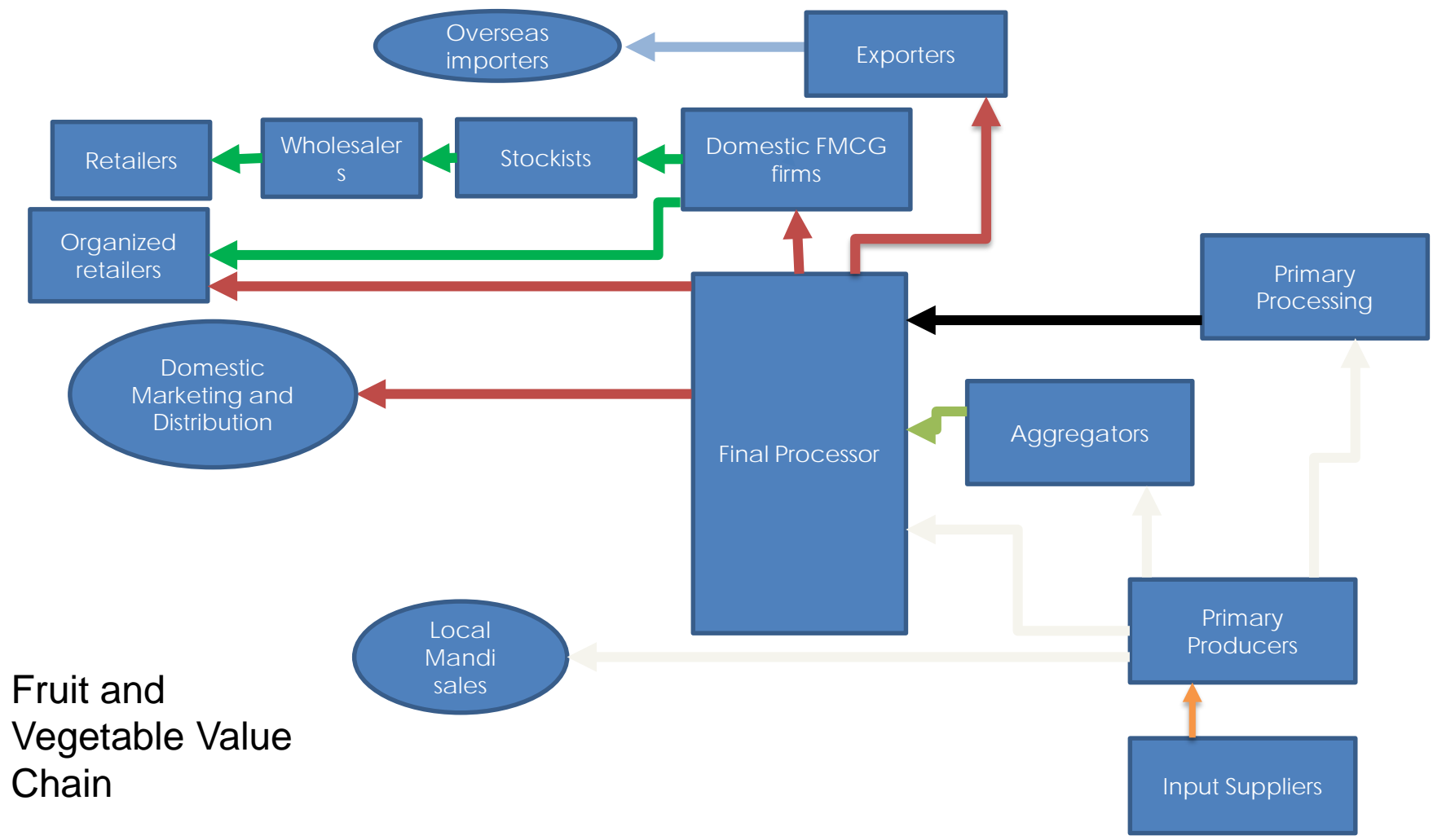
Packaging material manufacturers

Honey processing equipment manufacturers

Transport and freight services

Domestic /Local Market
 Domestic organised retail chains

Stakeholder map of the kandi fruit and vegetable cluster



Fruit and Vegetable Value Chain



Thanks