Value Chain Assessment of Climate Adaptation in Soy Sector

Study of Madhya Pradesh and Maharashtra

Supported by: SOLIDARIDAD

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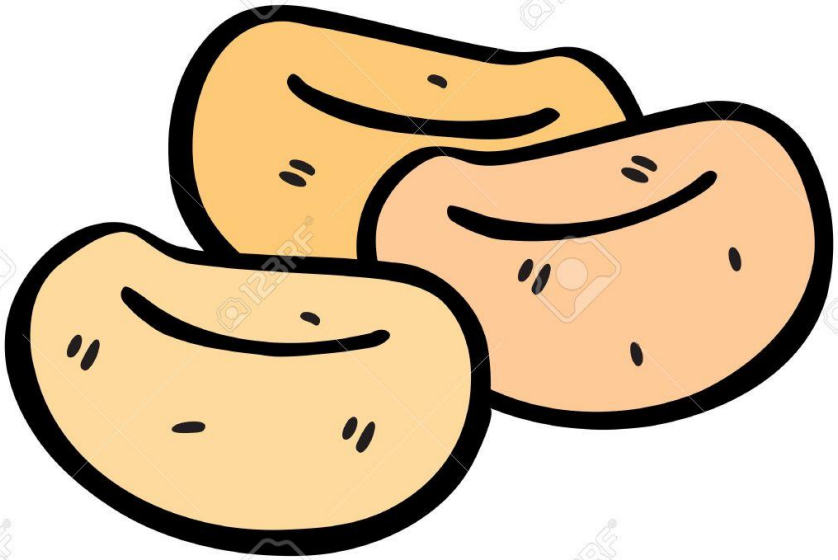
Layout of the Presentation

- Context of the Study
- Objectives of the Study
- Trends in Area, Production and Productivity
- Value Chain of Soybean
- Climatic Pathway of Risks and Impacts
- Response and Coping Strategies- Producers and Processors
- Adaptive Strategies



CONTEXT OF THE STUDY

Journey of Soy

- Cultivated soy (*Glycine max*) ancestor (*Glycine soja*) arose in Southeast Asia and travelled to Australia in South and China in north
- Yellow river region of China recognised as the place where domesticated soy originated (11 BC)
- Soy is one of the 5 sacred grains planted by Hou Tsi (Chinese God of Agriculture)
- Travelled to Brazil, America and Europe with returning missionaries (17-18 century)
- Came to India *via* Silk route around 1000 AD in the north east region

Journey of Soy

- Assam, Manipur, Sikkim, Kumaon region
- Produced as Kalitur referred to as Bhat, Teliakulth and Garrjakalay
- CP & B records cultivation of Soybean in 9 distinct varieties in 1913
- Mid 60s breakthrough in production called Pantnagar trials at Jabalpur 1.64 ton/ha
- Led to agriculture feasibility and decrease in maturity period from 134-139 days

Growth of Soy in 45 years

AREA

Increased by 386 times

14% of Gross Cropped Area

(second largest)

PRODUCTION

Increased by 856 times

IMPORTANCE

Protein 40% and Fat 18%

CONTRIBUTION

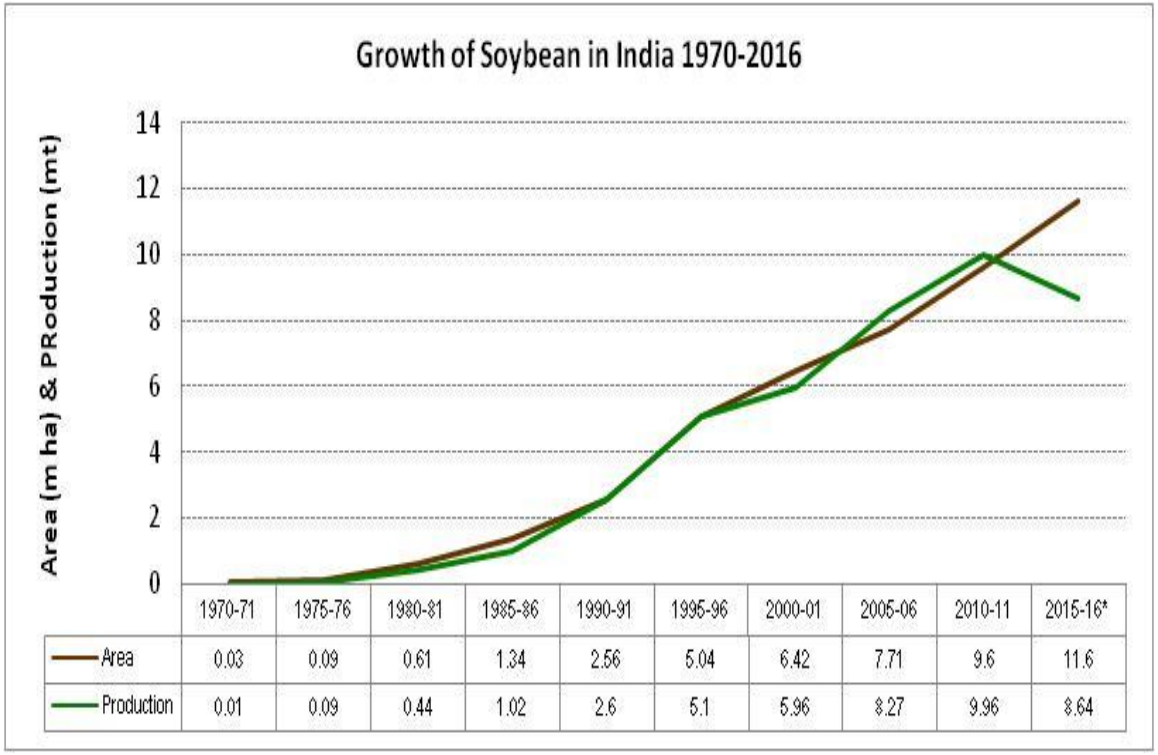
43% of total Oil seed

25% of Oil production

PEAK- 2012

Area 120.327 lakh ha

Production 120.832 MT



	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2010-11	2015-16*
Area	0.03	0.09	0.61	1.34	2.56	5.04	6.42	7.71	9.6	11.6
Production	0.01	0.09	0.44	1.02	2.6	5.1	5.96	8.27	9.96	8.64

Geographical Spread of Soy

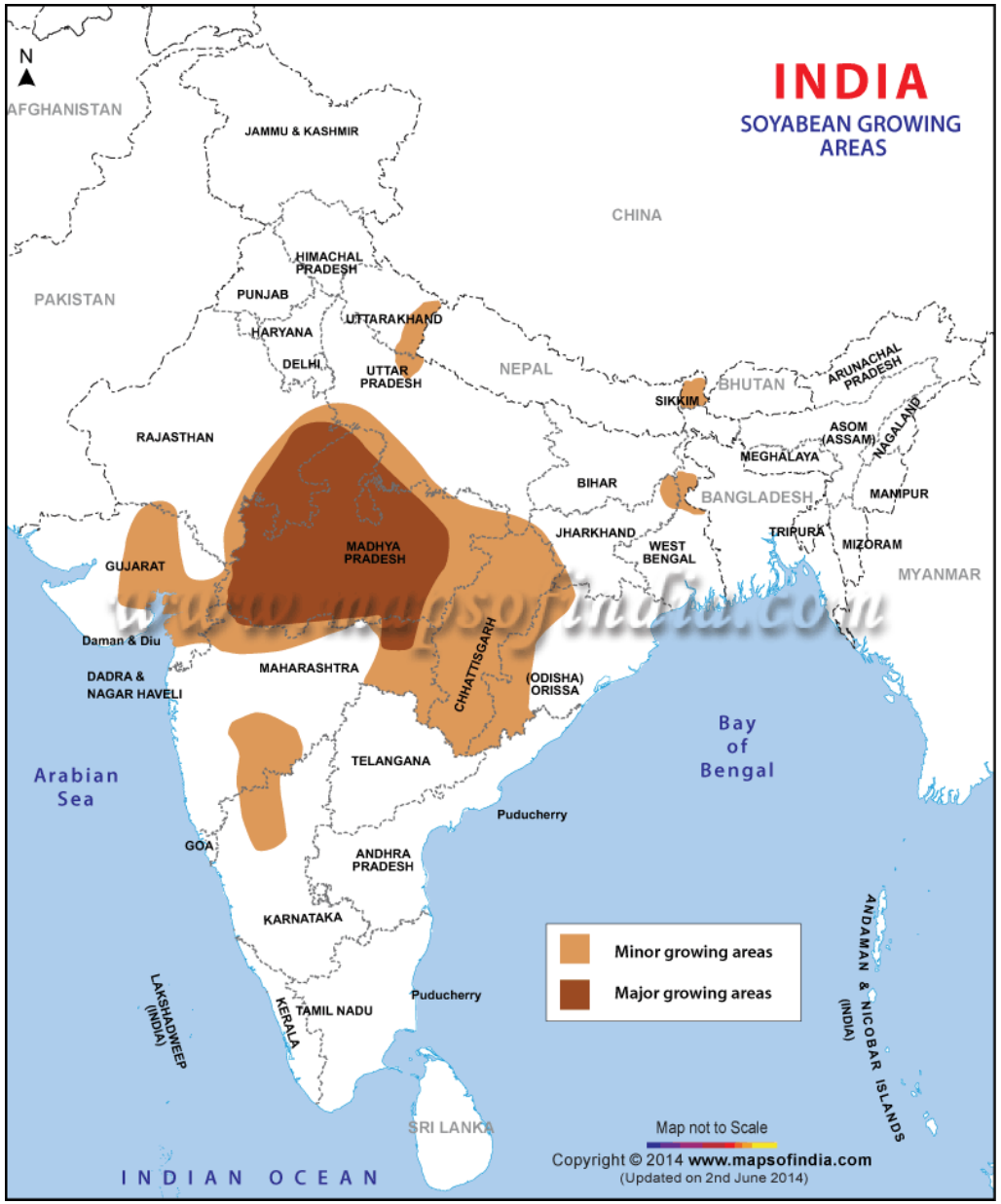
STATES

27 States of India

7 States area is negligible

MP and Maharashtra account for **87%** of the area

Rajasthan, Karnataka, Telangana and Chhattisgarh account for **12%**



Agro Climatic Features

AGRO CLIMATIC ZONES

Central Plateau and Hills

Rain: 470-1570 mm

Temp: 16.3-34.8^{o}C

Soil: Red & Black; Red & Yellow; Medium black Alluvial

Western Plateau and Hills

Rain: 602-1040 mm

Temp: 16.6-36.8^{o}C

Soil: Black

Eastern Plateau and Hills

Rain: 1271-1436 mm

Temp: 19.7-32.8^{o}C

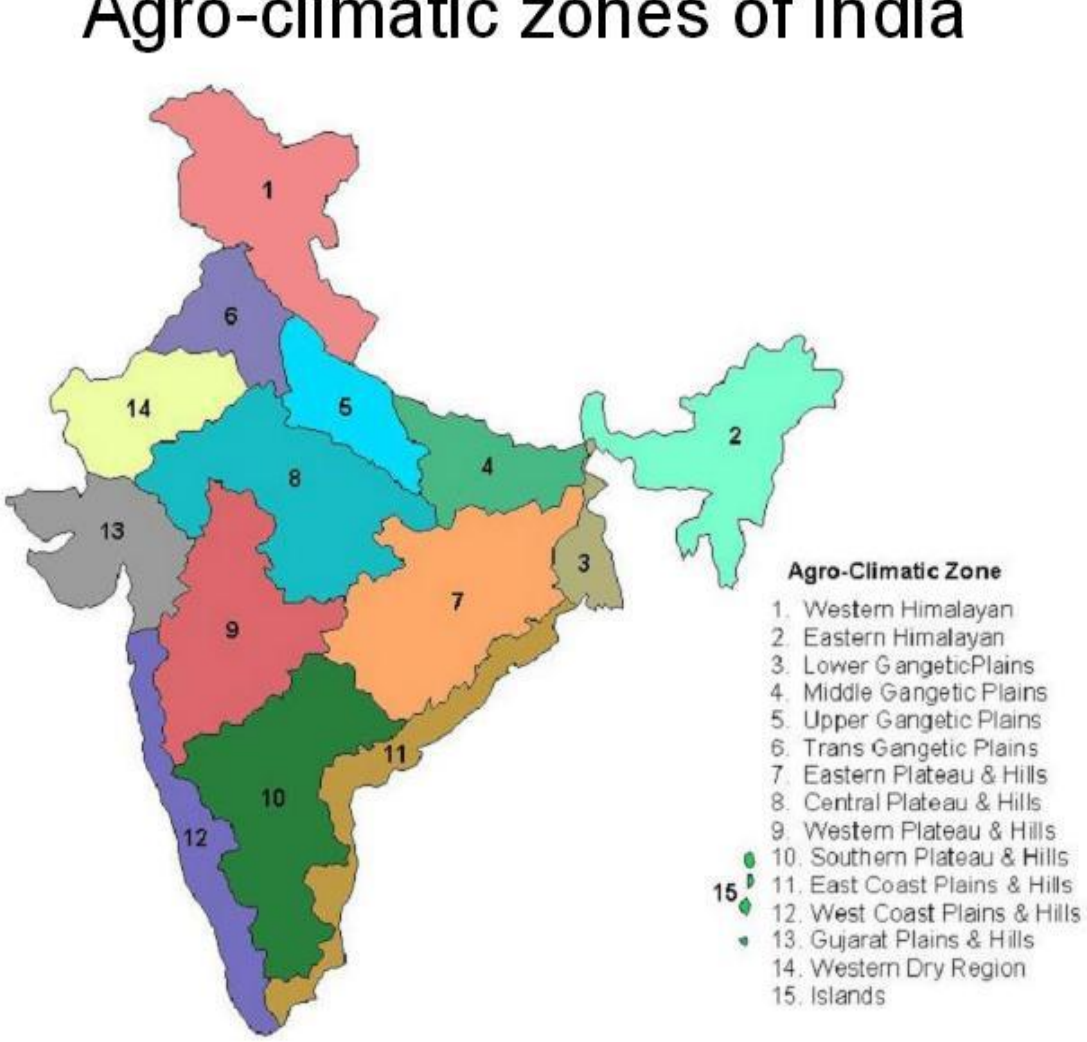
Soil: Red sandy; red & yellow

28 to 26^{o}N and74 to 82^{o}E

600-1500 mm

Hot semi arid to hot sub humid

Length of growing period 90-180 days



OBJECTIVES OF THE STUDY

Purpose of the Study

Goal

Develop a framework for climate resilient strategies for soy across its value chain so that adaptive capacities of the different players within the value chain is enhanced

Objectives

- Undertake vulnerability assessment of soy to climatic factors;
- Identify risk management strategies;
- Determine the role of financial instruments in enhancing the risk management and risk adaptive capacities; and
- Articulate strategic options to enhance the adaptive capacity of producers, processors, service providers and aggregators within the value chain of soy.

Methodology of the Study

- **Secondary Sources**
  - Review of existing information and data sets (production, productivity, package of practices, trade and industrial production, IMD data, financial data, policies)
- **Primary Sources**
  - **Sampling Plan**
    - **State**: Madhya Pradesh and Maharashtra
    - **Districts**: 3 in each state represent different agro climatic regions (Betul, Ujjain,Sagar/ Wardha, Buldhana, Latur)
  - **Respondent Group**
    - Input Suppliers, Producers, Procurers, Processors, Government, Academia

Method of Data Collection

- FGD with Soy Producers and individual interaction with other respondents

- **Areas of Inquiry**
  - **Trends** in changes in cost, quality, quantity, prices, preferences
  - **Practices** and their impact on soil health, natural resources
  - **Threats and Risks** increase in vulnerabilities, new groups
  - **Opportunities** new markets, new products and perspectives
  - **Support Service** banking, transport, insurance, warehouse
  - **Climate change** nature, trends, impacts, response to changes in climatic factors
  - **Partnerships** and collaborations among stakeholders
  - **Policy** response to climate change

TRENDS IN AREA, PRODUCTION AND PRODUCTIVITY

Soy Area and Production in MP and Maharashtra

AREA

Trend in India followed the same as in MP till 1992

Post 1995 steady growth in Soy in the country settling at 6 mha

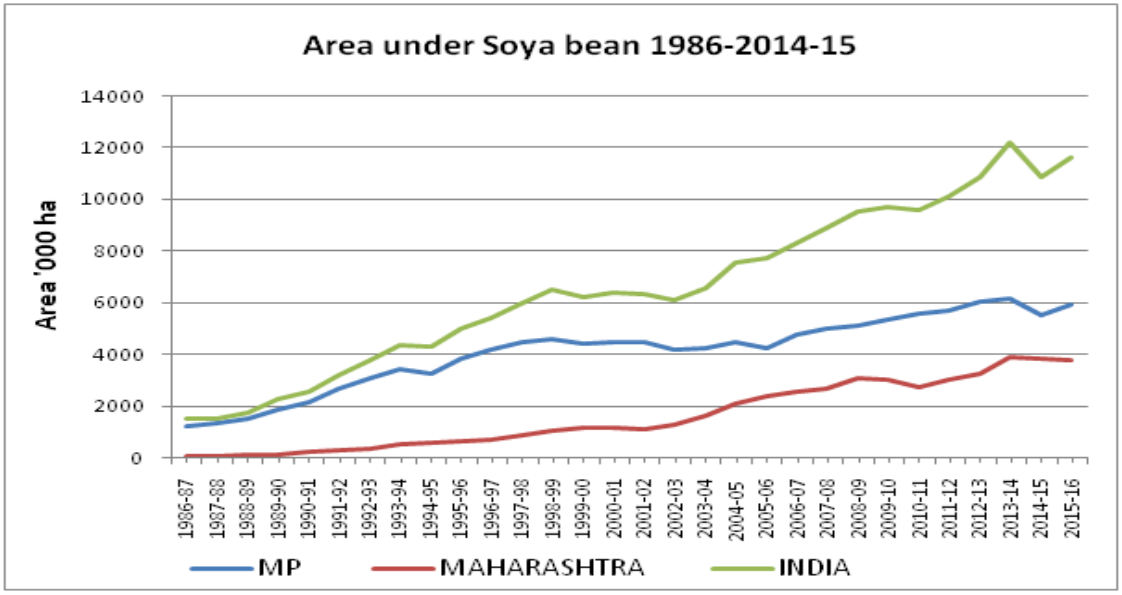
Post 2005 spurt in growth in area peaking at 12 mha

MP and Maharashtra have a rising trend in area under soy

Compound annual growth rate of Maharashtra is 16% of MP
6% (lower than all India growth rate of 7%)

Farmer's have by and large retained their trust in Soy and there have been no large scale migration from the crop

Coming of new areas in the two states and other states imply spread in the popularity of the crop amongst the farming community.



Yield of Soy MP and Maharashtra

PRODUCTION

MP have reached 6 mt even touching 7 mt

Maharashtra achieved production of 4 mt

All-India level crossed 14 mt once but has consistency of being above the 12 mt

Compound rate of growth of production for Maharashtra is 22.42% and MP at 9.47%

MP has frequent ups and downs along the upward rising graph

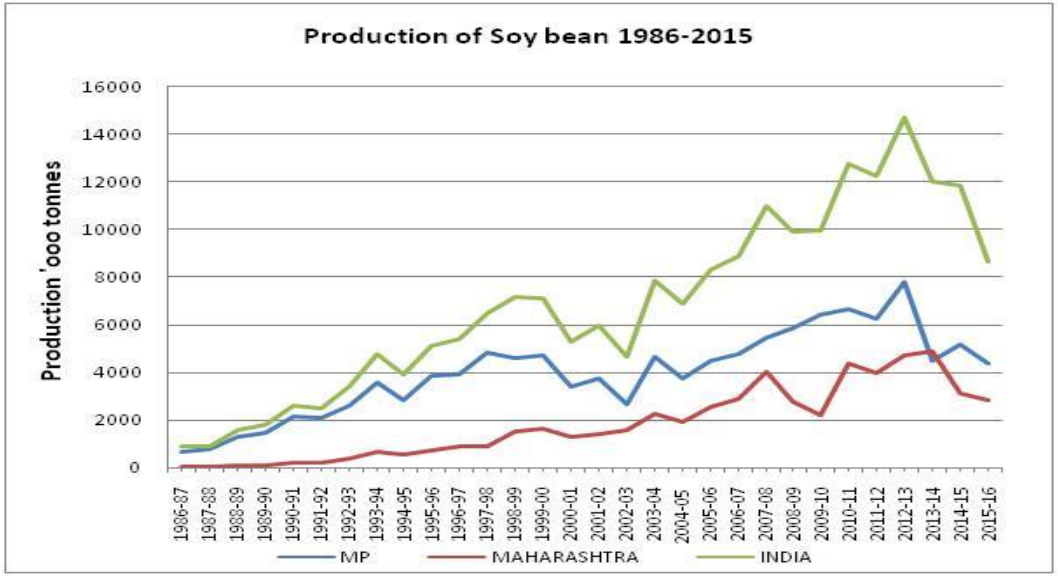
Greater resilience of soy production in Maharashtra than MP

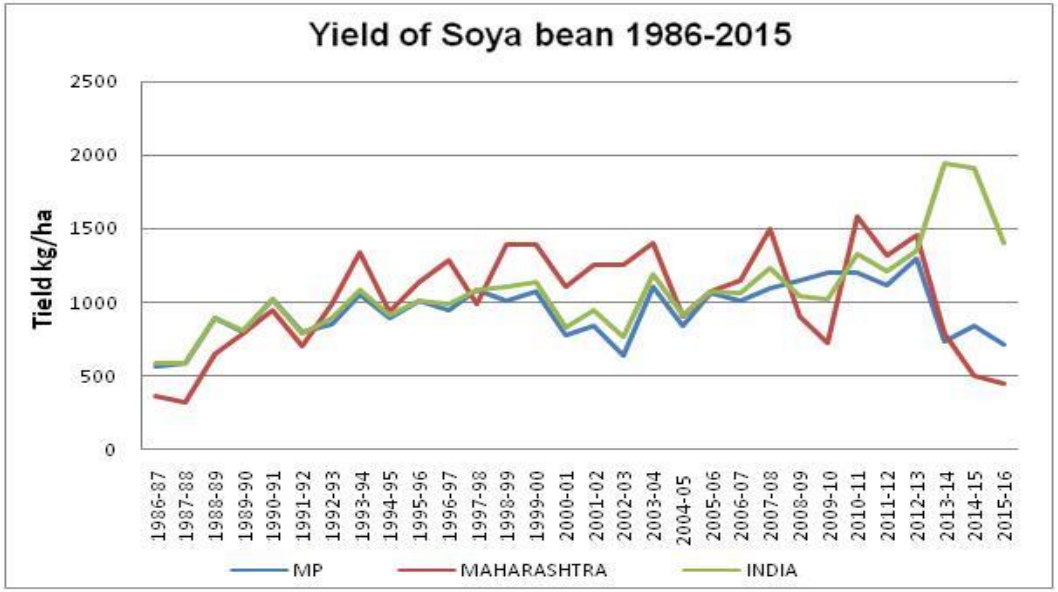
PRODUCTIVITY

1991 breakthrough in productivity when yield was recorded at 1 t/ha at the all-India level

Maharashtra yield grew at 5.26% per annum as compared to 3.4% for Madhya Pradesh and 3.16% at all-India level.

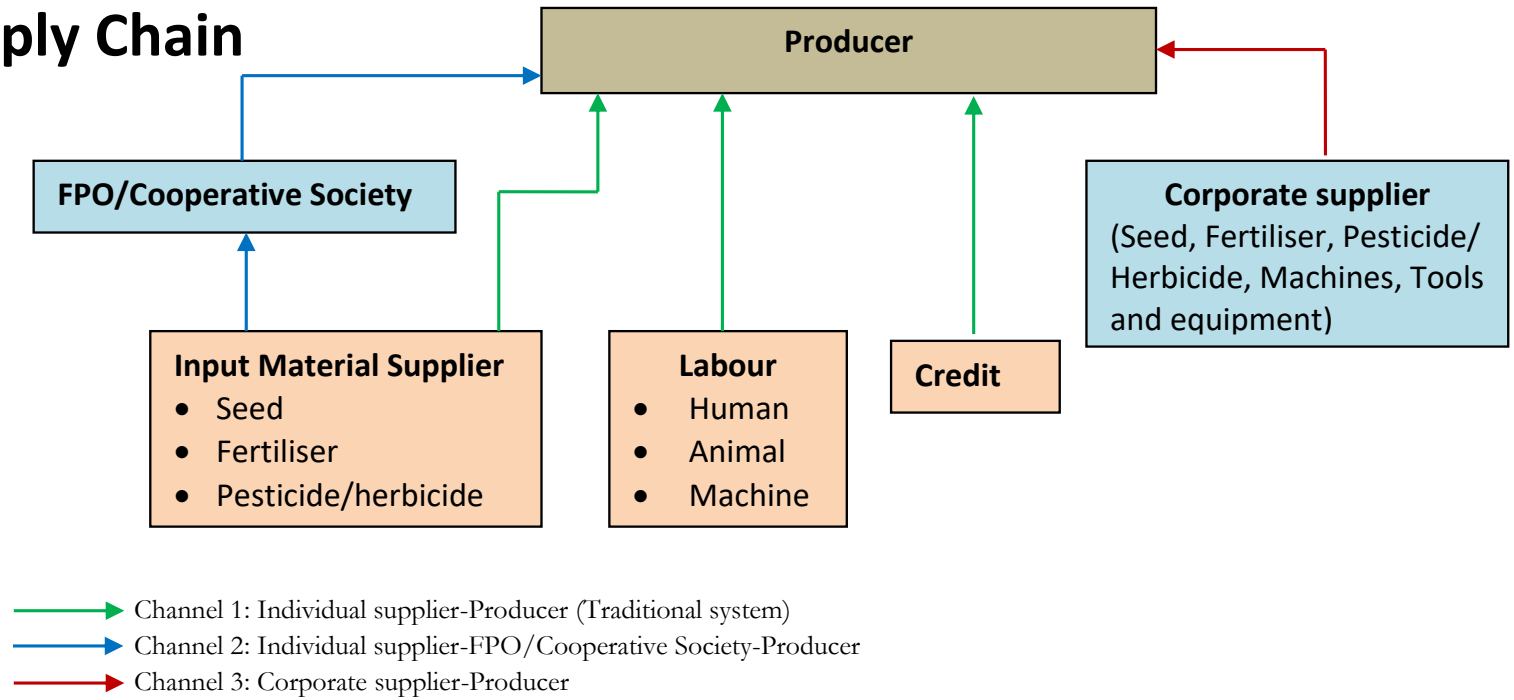
Trend in productivity has an undulating topographical path





VALUE CHAIN OF SOYBEAN

Pre Production
Input Supply Chain



- Mainly characterized by traditional agri system- each farmer goes to each supplier
- Emerging systems are corporatized minimizing stakeholders homogenous group goes to supplier or single window supplier
- Growing integration of farmers leading to their closer interface with structural changes in the agri-business sector

Production Structure of Soy

Labour and Rent of own land is more than half in MP and 42% in Maharashtra

All Labour is 40% in MP and more than 50% in Maharashtra

Seed cost is same in two states

MP spends higher proportion on plant protection and Maharashtra on fertilisers

Production cost per ha for MP Rs 22668 and for Maharashtra Rs 26554

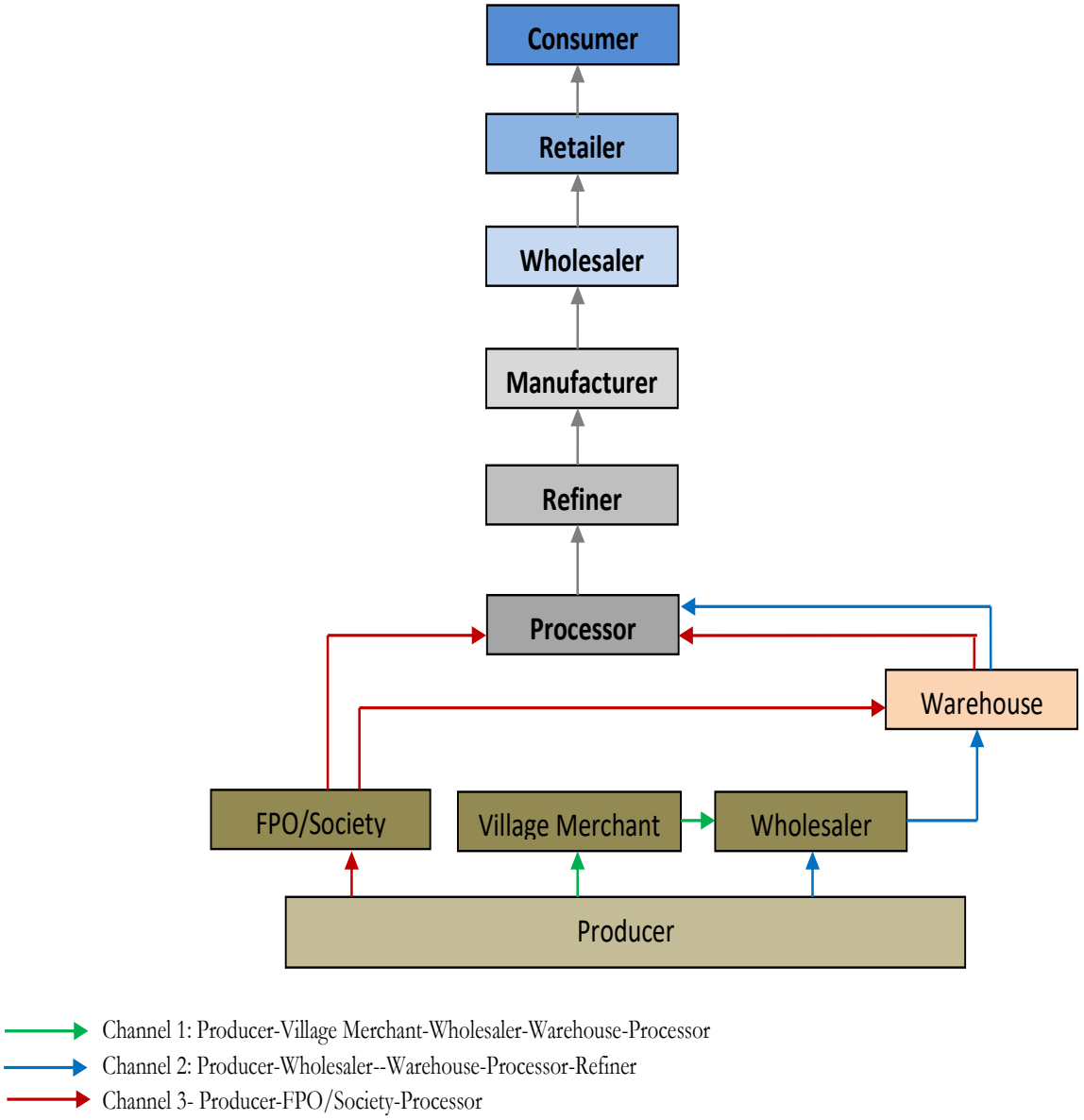
Input	Proportion to total cost of production (%)	
	Madhya Pradesh	Maharashtra
Human Labour	21.5	25.8
Animal Labour	4.7	14.3
Machine Labour	13.1	12.2
Seed	9.8	9.6
Fertilisers/Manure	5.4	8
Plant protection	4.4	2.4
Land	34.9	17.9
Others	6.2	9.6

Post Production Value Chain

85% of the marketed produce is sold through the traditional channel

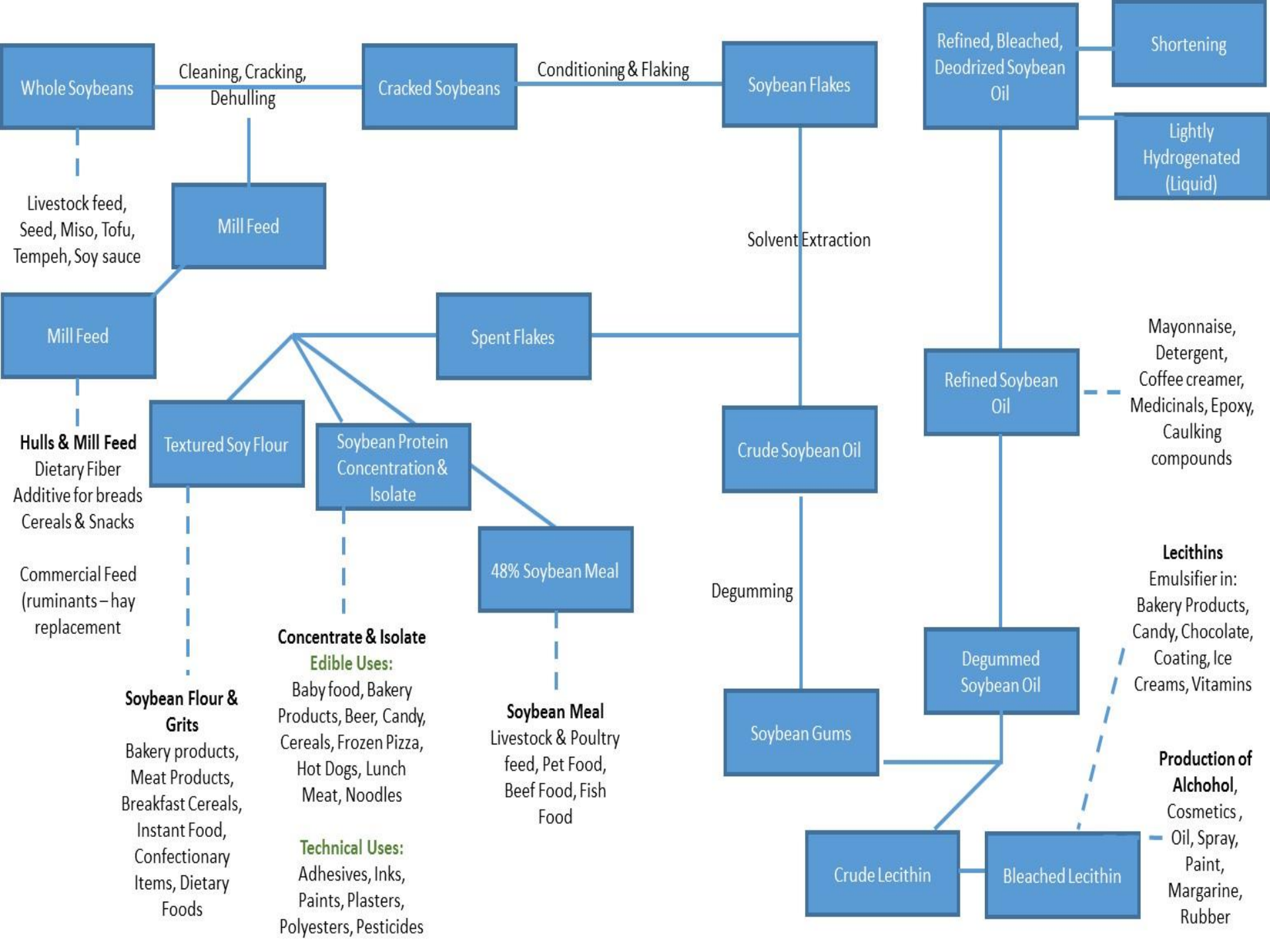
Each layer from producer to processor adds to transportation cost without adding any value to the product

Direct channel with the aggregator has the advantage where producer gets a higher return and processor discounted price



Utilisation of Soybean

- **Whole bean utilisation**
  - Roasted whole soybean and flour used in confectionary and snacks
  - Processing or fractionation for soymilk, soy sauce, tofu, yogurt, soy powder
- **Oil Mill route**
  - Pressing, extraction and refining
  - Oil and Meal fraction for human consumption (concentrates, isolates, textured proteins, spun fibers), Meal fraction for animal consumption (meal and cake)


Whole Soybeans
Cleaning, Cracking, Dehulling
Cracked Soybeans
Conditioning & Flaking
Soybean Flakes
Refined, Bleached, Deodrized Soybean Oil
Shortening
Lightly Hydrogenated (Liquid)
Livestock feed, Seed, Miso, Tofu, Tempeh, Soy sauce
Mill Feed
Solvent Extraction
Mill Feed
Spent Flakes
Mayonnaise, Detergent, Coffee creamer, Medicinals, Epoxy, Caulking compounds
Refined Soybean Oil
Hulls & Mill Feed
Dietary Fiber
Additive for breads
Cereals & Snacks
Commercial Feed (ruminants – hay replacement
Textured Soy Flour
Soybean Protein Concentration & Isolate
Crude Soybean Oil
48% Soybean Meal
Degumming
Lecithins
Emulsifier in: Bakery Products, Candy, Chocolate, Coating, Ice Creams, Vitamins
Degummed Soybean Oil
Soybean Flour & Grits
Bakery products, Meat Products, Breakfast Cereals, Instant Food, Confectionary Items, Dietary Foods
Concentrate & Isolate
Edible Uses:
Baby food, Bakery Products, Beer, Candy, Cereals, Frozen Pizza, Hot Dogs, Lunch Meat, Noodles
Technical Uses:
Adhesives, Inks, Paints, Plasters, Polyesters, Pesticides
Soybean Meal
Livestock & Poultry feed, Pet Food, Beef Food, Fish Food
Soybean Gums
Production of Alchohol, Cosmetics, Oil, Spray, Paint, Margarine, Rubber
Crude Lecithin
Bleached Lecithin

Soy Oil and Meal

VALUE ADDITION

Soy Oil	1.125%
Soy Milk	27.26%
Soy Milk	69.36% (Flavoured)
Tofu	54.49%
Tofu	81.05% (Flavoured)
Curd	55.24%

CONSUMPTION

India	2 gm per day
USA	9 gm per day
China	16 gm per day

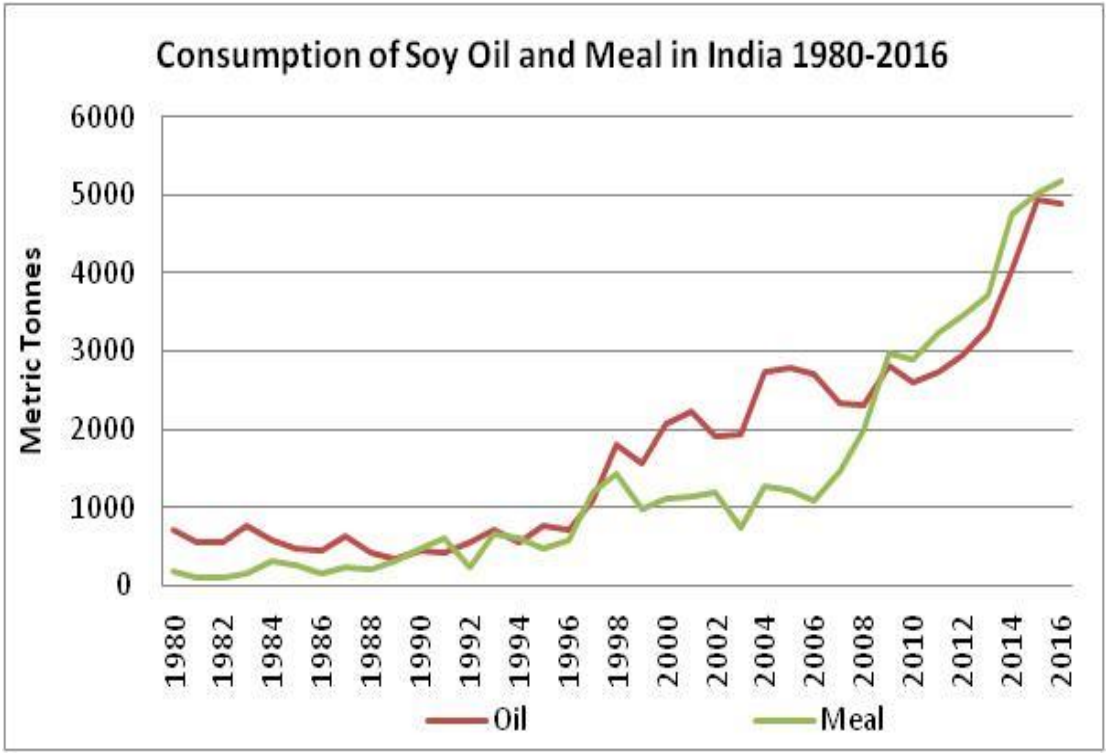
GROWTH

Expected to grow at 200% pa

Meal has overtaken Oil by 2016

Soy Oil no exports only domestic market

Soy Meal exports decrease by 70%



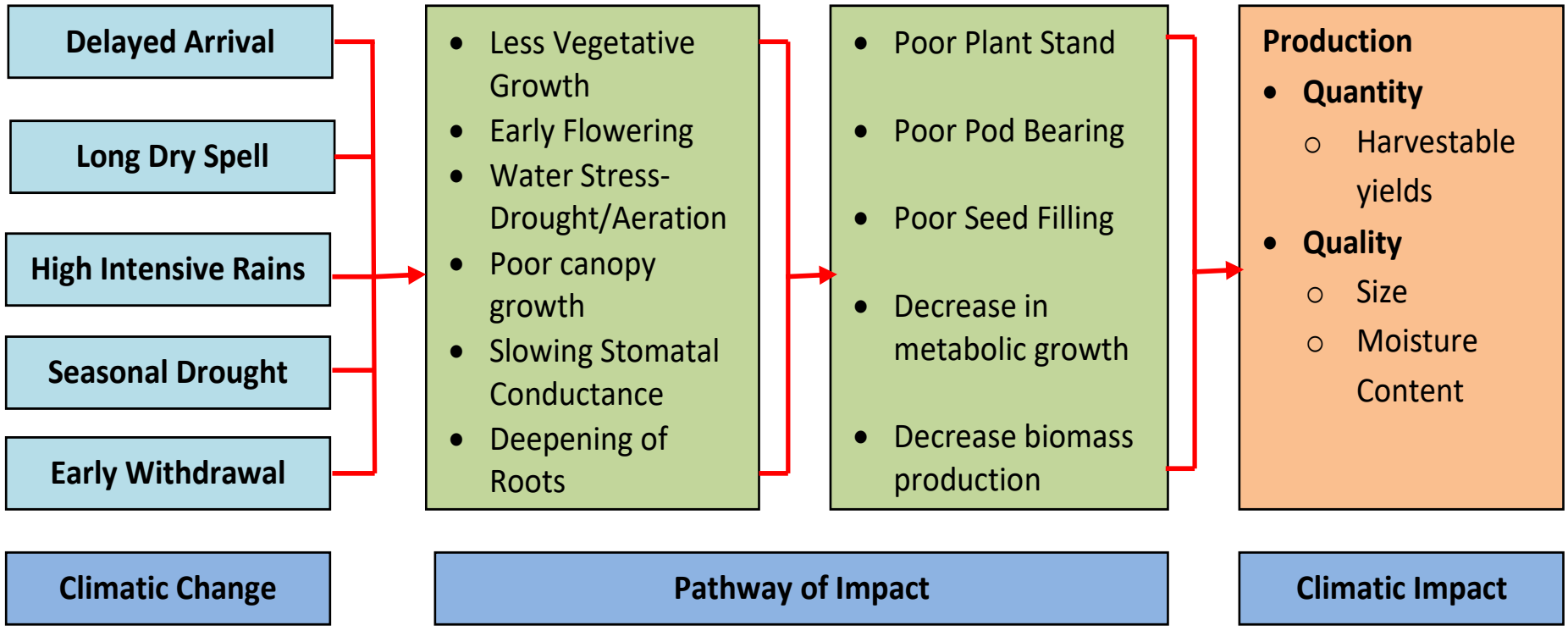
But…

- Main product of Soy industry is Soy Meal as animal feed
  - 80% to poultry
  - 20% fish, beef and other animal feed industry

CLIMATE CHANGE AND SOY

Climate Pathway of Risks and Impacts

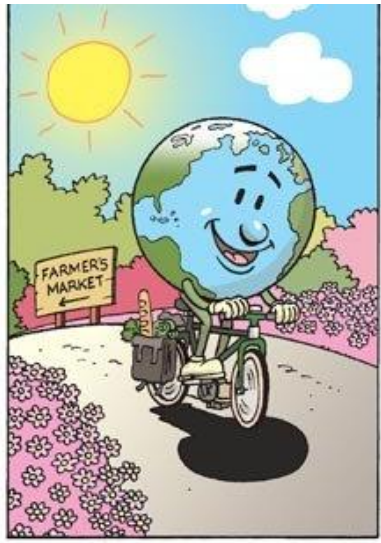
RAINS



Trends in Rainfall

District	June	July	August	September
Betul	D	D	I	D
Sagar	I	D	N	D
Ujjain	I	D	I	D
Wardha	D	D	N	D
Latur	D	I	I	D
Buldhana	D	D	I	D
Note: D=Decreasing; I= Increasing; and N= No change				

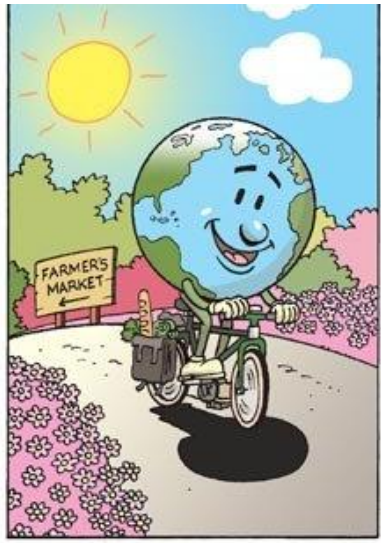
- Decline in early Sowing
- July rainfall decreasing making growth unpredictable
- Early withdrawal leading to shortening of cropping cycle



Trends in Rainfall

District	No of wet days		
	Lowest	Highest	Highest-Lowest
Betul	30	51	21
Sagar	29	50	21
Ujjain	25	47	22
Wardha	24	25	1
Latur	22	40	18
Buldhana	23	43	20

- Decrease in wet days implies increase in dry spells
- Difference bet highest and lowest implies unpredictability of rainfall

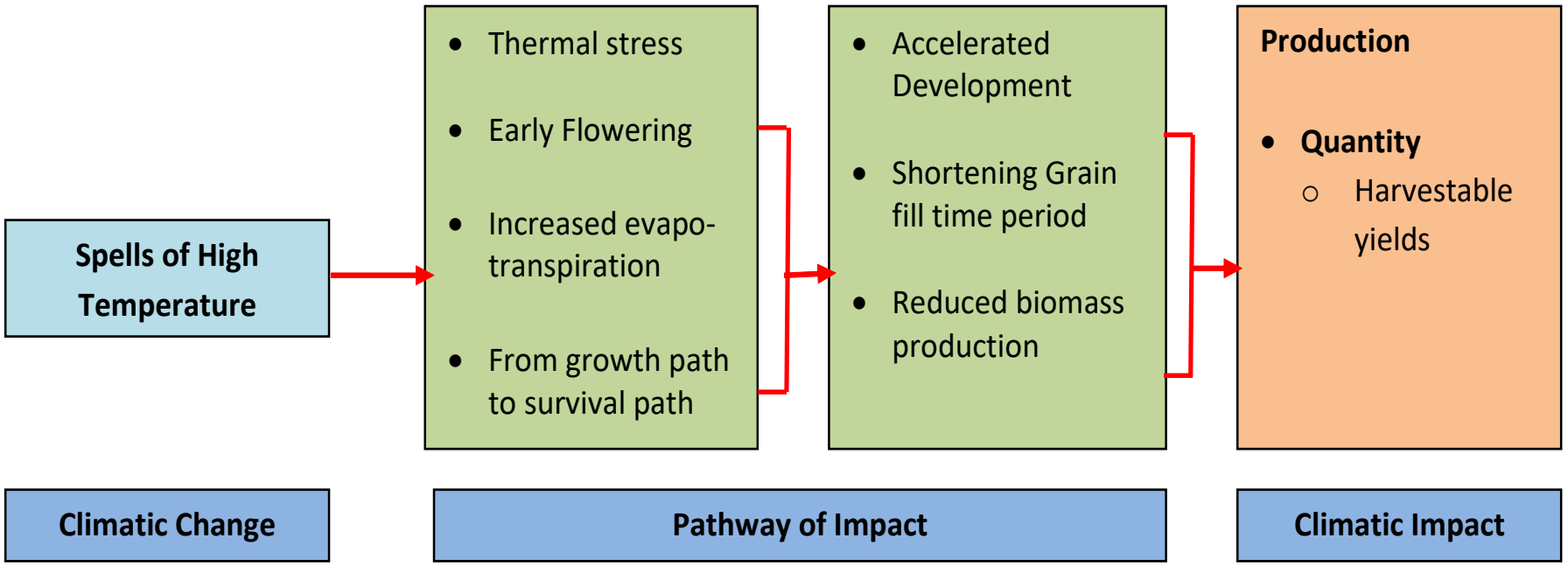


Trends in Rainfall

- Rainfall Anomaly (IMD) the actual rainfall in a region is either 20% in deficit or excess of the normal rainfall
- In six districts more than half the years are the years when there was either a surplus or deficit rainfall in **all the four months**
- Number of year of deficit are more than that of surplus issue of seasonal drought is more likely to happen than floods

Climate Pathway of Risks and Impacts

TEMPERATURE

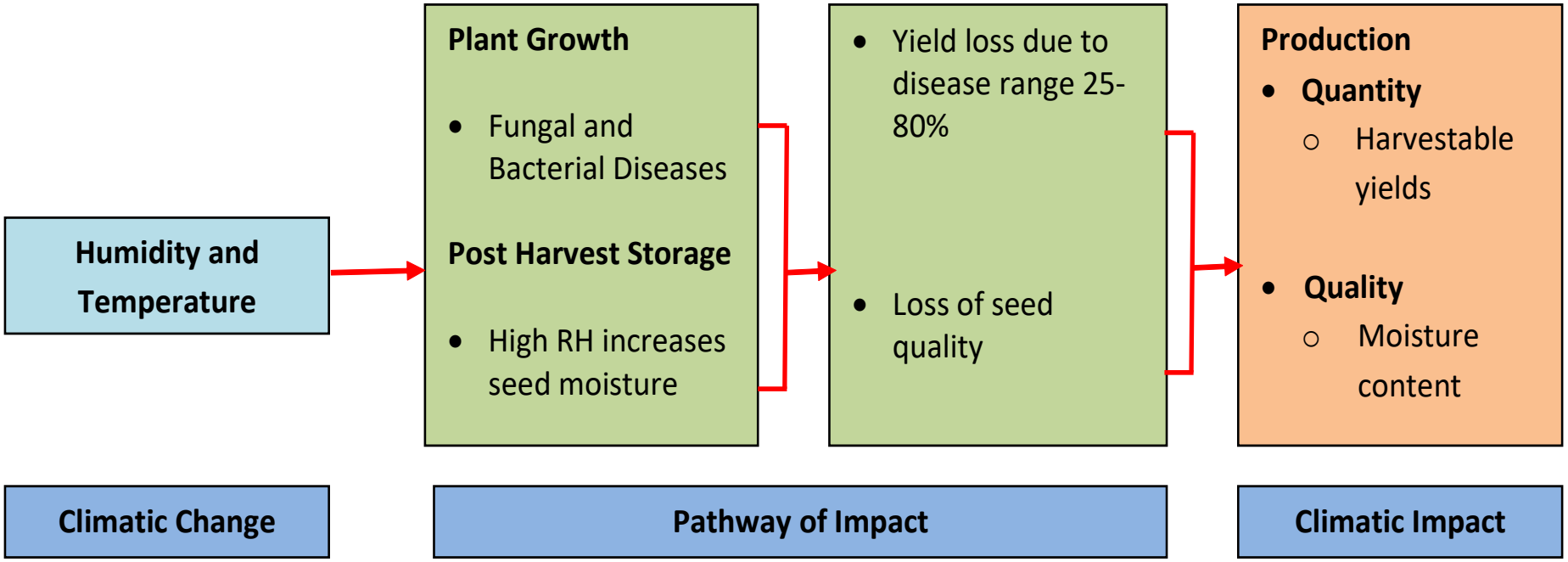


Trends in Temperature

- Trends for average maximum temperature (Jun, Jul, Aug and Sept) for selected districts indicate:
  - the districts are **getting warmer** wherein the trend is low for Betul, Ujjain and Wardha but it is quiet pronounced for Latur and Buldhana
  - the average maximum for all the six districts is **above the benchmark of 30°C** for the monsoon period as a whole.
  - average maximum temperature being more than 30°C in June the probability of thermal stress is **very high** for the month of June
  - probability of increase in thermal stress for the soybean crop is **getting real** and getting higher

Climate Pathway of Risks and Impacts

RELATIVE HUMIDITY



Climate Stresses and Impacts

Madhya Pradesh

"changes in climate in the future may lead to conditions which may not support sustainable crop production as productivity of crops is an integrated process of favourable climatic conditions as well as farm inputs"

Source: SAPCC

Maharashtra

"decline in soybean yields has been estimated to be **greater than 11%** of the present yield in the 2030s and is likely to further decline in the 2050s and 2070s approaching **a total decline of 36%** of the present yield."

Source: SAAPCC

RESPONSE AND COPING STRATEGIES- PRODUCERS

Seeds

- Preference for shorter duration varieties main reason is early withdrawal of monsoon (JS 95-60, JS 20-34, NRC 7 and others which matures in 85-95 days)
- Preference is for variety that requires less water
- Greater demand for certified seed and germination percentage is a quality parameter
- High Seed Rate 40-50 kg per acre
- Seed suppliers do not stock different varieties of seed (short and long duration); no rational estimate for stocking of seed
- Decrease in business of seed suppliers but they do not relate to climatic factors

Sowing

- Seed drill is used for sowing of soy seeds
- Seed depth maintained between 2 to 3 inches
- Seed treatment is negligible
- Plant spacing increased row distance between **12 to 18 inches** and plant to plant from **1 to 2 inches**
- Some farmers have adopted ridge and furrow practice of sowing (row distance 22 to 24 inches and plant to plant distance 8 to 10 inches)
- Farmers adding intensification technique make the distance between plants at 18 to 22 inches
- MP Soy a single crop in Maharashtra it is inter cropped with black gram or arhar

Soil and Ploughing

- **Soil**
  - Hardening of soil because of excessive use of fertilisers, decrease in organic content and decrease in moisture retention capacity of soil
  - Some farmers report resorting to deep ploughing every two years
- **Ploughing**
  - 3 to 4 ploughing as part of pre sowing operations
  - Preference for tractors as bullocks does not provide enough depth
  - Implications on cost structure of soy

Fertilisers and Pesticides

- **Fertilizers**
  - Suppliers- fertilizer off take is increasing indicating preference for chemical fertilizers has not peaked
  - Dosage of DAP is 40 kg per acre (increased from 25 kg per acre)
- **Pest, Weed and Disease Management**
  - Weed managed through manual labour by dora/kulpa; spray is seldom used as farmers find the cost of herbicide to be high
  - White fly, Stem fly and Girdle Beatle are common pests for which use of pesticides is common
  - Yellow mosaic dominated the response of the farmers
  - Pesticide suppliers report increased use of pesticides and disease related chemicals; greater diversity is stocked in their shops
  - Suppliers not aware of the impact of climatic factors on the emergence of pest and diseases and they are entirely dependent on the companies for the supplies

Climate Adaptation Deficits

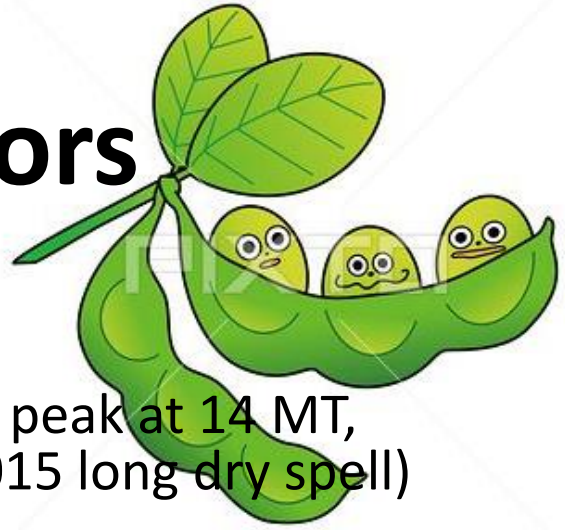
- Lack of different **qualities** of seeds in the market- limited choices for farmers
- Non availability of seed- that farmer can opt for **after** the arrival of monsoon
- **Undeveloped** Protective irrigation facilities/ practices - farmers unable to take advantage of long duration crops
- Ridge and Furrow **not popular** among farmers

Climate Adaptation Deficits

- Limited **risk management** strategies- seed treatment; germination tests; long term soil health restoration; insurance
- Lack of **information** on temp, humidity and disease pest attacks
- **Unreliable weather forecasting** system farmers work in high uncertainty regime
- DRRs of government not geared for **preventive and adaptive measures**

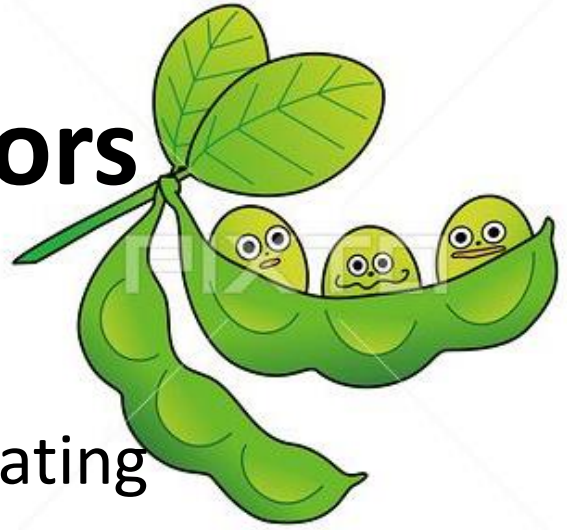
RESPONSE AND COPING STRATEGIES- PROCESSORS

Impact on Processors



- **Change: Quantity of Grain**
  - Fluctuating quantity of soy produce (eg 2012 peak at 14 MT, 2013 heavy rains, 2014 delayed monsoon, 2015 long dry spell)
- **Response: Processors working with Producers**
  - Maharashtra Processors and Producers working on quality of seed
- **Change: Quality of the grain**
  - Small grain is not preferred (less than 4mm not accepted)
  - Grain with moisture content up to 10-12% preferred (tested in factory)
- **Response: Area of Procurement**
  - Widened the area of procurement to increase their basket of choice

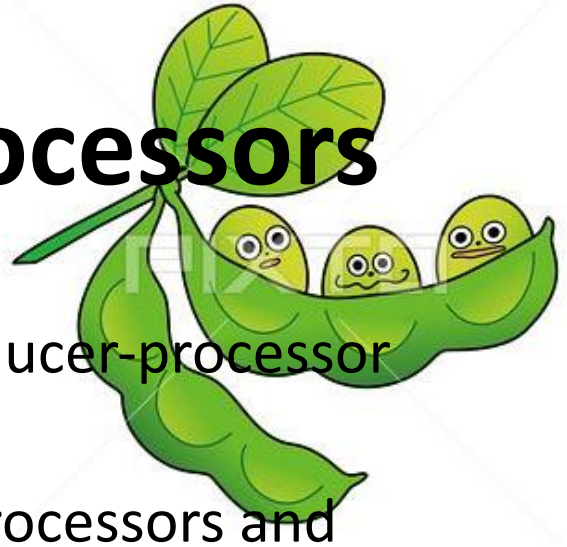
Impact on Processors



- **Impact: Capacity Utilisation**
  - 50 % of the existing plants are operating
  - Better plants are able to work on 60% capacity utilisation of Soy plants

- **Response: Plant Modification**
  - Slight modification mustard and cotton oil extraction plant
  - Major modifications to groundnut oil processing

Adaptation Deficits- Processors



- Absence of institutional mechanism for producer-processor dialogue
- Absence of innovative climatic finance for processors and producers to bring long term changes in processing
- Large yield gap necessitates research on productivity; yet Processors do not use existing research to access identity preserved varieties and collaborate with farmers through contract farming practices. (eg varieties suitable for food use, high oil content etc)
- Absence of climate credit systems for processors who choose to work closely with farmers and protect them from climatic unpredictability

ADAPTIVE STRATEGIES

Framework for Adaptive Strategies

		Anticipatory	**Reactive**
Natural Systems			
Human Systems	Private		
	Public		

		Anticipatory	Reactive
Natural Systems		**Ecological Perspective** Enhancement of **organic capacity of soil** Revisiting water harvesting structures and **irrigation practices**	Climate **Resilient** DRRs
Human Systems	Private	**Adaptive** Package of Practices (RFF) Limited demand for different **seed variety** **P-P interface**	Climate indexed **Insurance**
	Public	Multiplication of breeder seed to meet certified seed demand Weather **Forecasting** Climate **Finance**	**Weather** Monitoring System Disaster **Relief**

Thank You