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Agricultural Outlook and Situation Analysis Reports

Fourth Semi-annual Medium-term Agricultural Outlook Report

Project Sponsored by

Department of Agriculture, Cooperation and Farmers Welfare
Ministry of Agriculture and Farmers Welfare
with Technical Support from Food and Agriculture Organisation

September 2015

National Council of Applied Economic Research

About the Project

The need for monitoring and analysis of emerging food scenarios is important for India both because of significant dependence of output on the monsoon rains and the fact that globally India is one of the major consumers of food crops influencing markets. Management of agriculture from a public policy perspective requires organisation of this information and analysis as inputs to policy making.

Against this backdrop the National Food Security Mission (NFSM), Ministry of Agriculture, commissioned a 3–Year study to National Council of Applied Economic Research (NCAER) in 2011–12 to bridge this important gap in analytical inputs for understanding the emerging agricultural scenarios both in the short-term of one or two quarters and also in the medium to longer term.

Accordingly, the agricultural outlook and situation analysis undertaken in this study refers to the main crop based food items: cereals (specifically rice, wheat, jowar, bajra, maize and overall coarse grains), pulses (gram, tur), selected fruits and vegetables (banana, potato, onion), sugarcane and edible oils (groundnut, rapeseed/mustard, soybean). In addition the analysis also covers milk, one livestock product.

From January 2015, the Ministry has approved continuation of the project for the remaining period of the Twelfth Plan.

The main objective of the grant during January 2015 – March 2017 is to sustain the work programme established in the previous grant period. The activities will be more focused on model-based analysis in the medium-term assessment. A forum for broad based consultations on the emerging outlook in the short-term would be developed. Efforts would also be made to involve the state-level agricultural departments in the discussion of emerging outlook for the sector. More high-value agricultural commodities, viz. horticulture and dairy products would be included in our analysis.

Main outputs of the project are:

1. Biannual Season-wise Agricultural Outlook Reports: These will cover the assessment of the output, prices and markets in the short-term including the global scenario.

2. Annual medium-term Agricultural Outlook Reports: These will cover an assessment of outlook in terms of production, utlilisation, trade and prices for the major food commodities from national and global perspectives. The medium-term outlook assessment will utilise an adapted version of FAO-COSIMO model besides the econometric model presently being used for analysis.

3. Meetings/workshops: The representatives from industry, academia and government would be invited to share their assessment of commodity outlook on production, demand, prices and trade. These meetings will be organised by NCAER with the active support and participation by the Ministry of Agriculture. NCAER will provide a background review paper for the meetings and would also request for presentations by other experts on major commodity sectors.

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Disclaimer: The information and projections contained in this report are result of study conducted by NCAER and the views expressed do not necessarily reflect those of Ministry of Agriculture and Farmers Welfare.

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Shekhar Shah
Director-General

PREFACE

Agriculture's share in the India's GDP is shrinking, but it continues to account for a high share in employment and livelihoods in the Indian rural economy. And India's overall GDP growth is still quite closely tied to agriculture and allied sector growth due to weather related shocks.

At least four major problems confront Indian agriculture. *First*, average farm holding size is shrinking, posing challenges such as a rising farm populations per farm hectare and declining per capita farm incomes, the difficulty of delivering agricultural credit and crop insurance to an increasing number of small and marginal farmers, the poor viability of farm mechanization in the absence of scale economies, and the poor sourcing of produce due to lack of grading and standardization with fragmented marketable surplus.

Second, Indian agriculture after nearly 70 years of policymaking by the Union and State Governments is still largely dependent on the summer monsoon. Out of some 141 million hectares of net area sown, only about 65 million hectares, or 45per cent, is puposively irrigated. The Modi Government has approved a new irrigation scheme, the *Pradhan Mantri Krishi Sinchai Yojana* (PMKSY), amalgamating a host of other existing schemes, which when implemented is supposed to ensure that all farms will have access to some means of protective irrigation and will produce "per drop, more crop." PMKSY plans to spend Rs 50,000 crores over the next five years.

Third, India's Agricultural Produce Market Committee Acts in different States allow farm sales only in regulated yards or mandis, with much evidence showing how these unfairly hinder fair price realization by farmers and lead to wide regional price disparities and price fluctuations. The Modi Government has recently approved the creation of an online National Agricultural Market trading platform that will allow farmers and traders to sell their produce to buyers anywhere in the country.

Fourth, poor agriculture infrastructure, such as storage, processing, cold chains and supply logistics, requires substantially greater private (both domestic and international) and PPP participation in these areas. The government is seeking to encourage private investment in agri-infrastructure with announcements of policy decisions and projects, but FDI in food retailing and supply chains continues to remain politically contentious.

The Indian Government is putting in place a complex set of policies on both the demand and the supply side to try to address these daunting challenges. These complexities make an ongoing, periodic, and regular assessment of the food and agricultural sector vital for good policymaking. This is also the global best practice recommended by the Food and Agriculture Organisation and OECD. The National Food Security Mission (NFSM) of the Union Ministry of Agriculture has entrusted NCAER this task of regularly assembling, researching, and disseminating information on key indicators on food commodities in an integrated manner.

The ***NCAER Agricultural Outlook and Situation Analysis Reports*** provide both quarterly and semi-annual assessments. These reports both document short and medium-term developments in the food economy and provide

an assessment of the emerging outlook. The NCAER reports are available from the NCAER website (www.agrioutlookindia.ncaer.org) and the website of the National Food Security Mission (http://nfsm.gov.in/NCAER.aspx).

This September 2015 offering is NCAER's fourth ***Semi-Annual Medium-Term Agricultural Outlook Report***. Besides presenting the regular, medium-term outlook for India, it also presents a global food commodity outlook based on comparing medium-term agricultural projections by the OECD/FAO, the US Department of Agriculture, the Food and Agricultural Policy Research Institute in the US, and the International Grains Council. For this work, NCAER has also developed a new AGLINK-COSIMO India model, a first for India, and has used the NCAER India COSIMO Model for its projections.[1] Recognizing the importance of horticulture in providing better returns to farmers, improving nutrition, and diversifying Indian agriculture, this Report also provides a special chapter on horticulture.

I am grateful to Dr Rajesh Chadha, Senior Research Counselor at NCAER, who has ably led the NCAER agricultural team after its previous lead researcher, Dr Shashanka Bhide, left NCAER in 2014. I am grateful also to Dr Bhide for his continued advice and support to the project despite his many onerous duties as the new Director of the Madras Institute of Development Studies. Other key members of the team include Dr. A. Govindan, Dr Laxmi Joshi, Mr V. P. Ahuja, Dr Charu Jain and Dr Seshadri Banerjee at NCAER and Dr Parmod Kumar at ISEC in Bangalore. The team and I greatly value the contributions of Dr A. Govindan, who has played a vital role in the finalisation of this report despite a serious illness.

I am once again extremely grateful to the Ministry of Agriculture for giving NCAER this opportunity to develop and present this important series of forward-looking outlook reports for the food and agriculture sector in India and the rest of the world. NCAER's work has benefitted not only from the Ministry's financial support but also from the very active and regular consultations senior Ministry staff have held with the NCAER team.

I am delighted that these NCAER Reports for the National Food Security Mission are filling an important information gap to build and maintain a longer-term perspective of the food sector and to ensure India's food and nutrition needs. I look forward to NCAER continuing to work closely with the Ministry of Agriculture and other branches of government on this important set of policy challenges.

New Delhi
September 27, 2015

Shekhar Shah
Director-General
NCEAR

SIRAJ HUSSAIN
SECRETARY

सत्यमेव जयते

भारत सरकार
कृषि एवं किसान कल्याण मंत्रालय
कृषि, सहकारिता एवं किसान कल्याण विभाग
Government of India
Ministry of Agriculture & Farmers Welfare
Department of Agriculture, Cooperation
& Farmers Welfare

FOREWORD

India has recorded significant growth in cereal production making the country not only self-sufficient but also an exporter of grains. However, the growth performance in oilseeds and pulse production has been less spectacular, making the country increasingly dependent on imports to meet the increasing demand, posing a challenge to food security. However, India has registered a remarkable growth in the horticulture and dairy sector making the country a net exporter of these items in value terms.

With the removal of quantitative restriction and softening of phytosanitary restrictions on trade, and lowering of import tariffs, Indian agriculture is getting increasingly integrated with the global market. To take advantage of this new opportunity, India has to enhance the productivity and quality of its farm products. The Government has taken several initiatives in this regard which includes Pradhan Mantri Krishi Sichai Yojana (PMKSY) which would ensure irrigation to every farmland and this is expected to increase the productivity of Indian farmers, particularly small and marginal farmers and help in diversification of crops. The Government is also working on new Farm Insurance Policy which would provide protection and assurance to farmers against unforeseen crop losses. The Government initiatives of setting up of National Market will also help in better price realization for the farmers and incentivize for increasing productivity.

The NCAER is working in coordination with Ministry of Agriculture and Farmers Welfare, Directorate of Economics and Statistics for long term assessment of demand and supply for agriculture sector. This assessment report by the NCAER helps in sound policy making. The present Annual Medium-Term Outlook Report has highlighted the emerging supply demand scenario for major food commodities based on a standalone Model projection for Indian Agricultural Markets using the OECD/FAO developed COSIMO Model for medium term projection. The Report has also analyzed horticulture crops situation in India as it has emerged as a provider of better nutrition to the common man and better returns to farmers and as a provider of better alternative for diversification of Indian agriculture.

I expect the findings of the report will be useful in addressing the new challenges emerging for the agriculture sector.

(Siraj Hussain)

Date: September 17, 2015

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Highlights

- In this report, we have attempted to compare the latest medium-term projections for wheat, rice, coarse grains, oilseeds, vegetable oils and sugar made by four international institutions (OECD/FAO, USDA, FAPRI, and IGC) on the supply and demand conditions for the world and India. The goal of this comparison is not to highlight absolute projection values, which result from the different assumption and structure of the models, but focus on highlighting common and diverging trends across projections as well as identifying uncertainties that could significantly impact markets.
- A standalone model for Indian agricultural markets, using the OECD/FAO developed COSIMO model and an econometric model have also been developed and applied by NCAER for its medium-term projections.
- Realising the importance of horticulture crops in providing nutrition and better returns to farmers and as a means for diversification of Indian agriculture, a chapter in the report focuses on the horticulture.

Acknowledgements

The study team wishes to acknowledge the guidance, support and encouragement of Mr Siraj Hussain, Secretary, Department of Agriculture and Co-operation in the conduct of the study. Ms Sangeeta Verma, Economic & Statistical Adviser, Directorate of Economics and Statistics and Mr Sanjay Lohiya, Joint Secretary (Crops) have provided valuable guidance to improve the content and coverage of the report. A number of officials from the Ministry and DES have provided data and opportunities for interaction and guidance in the course of the study. Dr S. K. Mukherjee, Adviser, DES and Nodal Officer for the study, has encouraged us in our work, providing feedback and data whenever requested.

Dr Shashanka Bhide, Director, Madras Institute of Development Studies, has also provided guidance and support in the conduct of the study. Mr Bhaskar Goswami of FAO, Delhi has provided technical support for the study.

Reports of the OECD/FAO, USDA, IFPRI and IGC and the Department of Agriculture and Co-operation have been major sources of data and information for the report. We have used information and data from a number of other sources also. Specific references used for our assessment of outlook in the report have been cited appropriately.

Dr Shesadri Banerjee, NCAER, visited FAO in Rome for 4 weeks to become familiar with the operation of the COSIMO model through interactions with experts there. NCAER would like to thank FAO for enabling this visit and sharing the programmes, data and access to software for solving the model.

Study Team

Rajesh Chadha (Project Leader), A. Govindan, Laxmi Joshi, V. P. Ahuja, Charu Jain, Shesadri Banerjee, S. K. Mondal and Ishita Gambhir from NCAER
and
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Contents

List of Tables

(Contd...)

List of Figures

(Contd...)

(Contd...)

(Contd...)

List of Appendix

CHAPTER I

Introduction

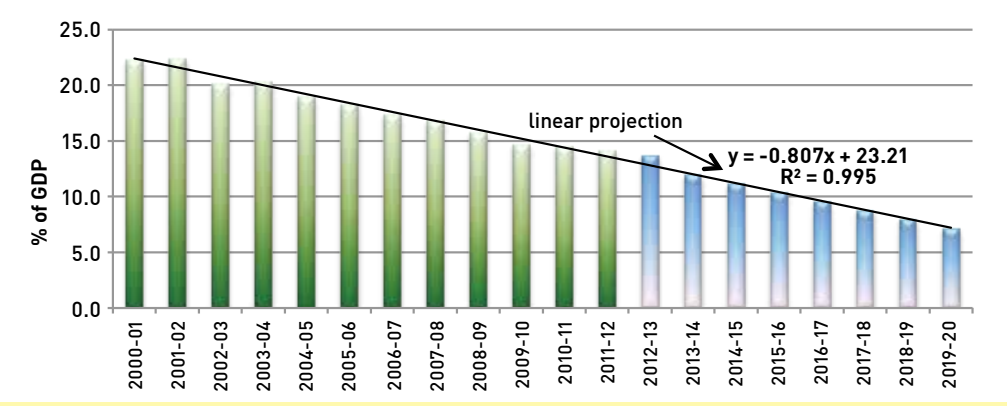
I.1 Constraints and Challenges

Agriculture is the mainstay of the Indian economy because of its high share in employment and its role in the supply of food commodities. Although the share of agriculture and allied sectors in GDP has declined steadily over the years, there is a high degree of correlation between India's GDP growth and growth in agriculture. According to the National Agricultural Policy declaration, a four per cent growth in agriculture is necessary to achieve 10 per cent increase in GDP. The following are some of the striking feature of Indian agriculture in recent years.

I.1.1 Declining Share of Agriculture in GDP

Despite growing at about 3 per cent each year on an average over the last four decades or so, the role of agriculture in India's economy has been declining sharply. The share of agriculture (which also includes livestock besides crops) and allied sector (forestry and logging and fisheries) in aggregate GDP has declined steadily over the past several decades from as high as over 50 per cent in the 1950s to around 14 per cent in recent years, a pattern typically exhibited by economies as they develop. This is largely attributed to demand patterns and also relatively lower demand on limited natural resources from non-agricultural sectors, particularly the services sector, which enable the latter to grow with lesser constraints. The key challenges faced at present by Indian agriculture on the production side are shrinking land base, inadequate water resources and the vagaries of nature, shortage of labour and increasing cost. With the growth rate in the agricultural sector likely to fall significantly short of overall economic growth of 6 to 7 per cent in coming years, the share of agriculture GDP to the overall GDP will continue to decline. If the current trend continues, agriculture's share in aggregate GDP may decline to less than 10 per cent by 2019-20 **(Figure I.1)**.

Figure I.1: Agriculture and Allied Sector GDP Share in Overall GDP

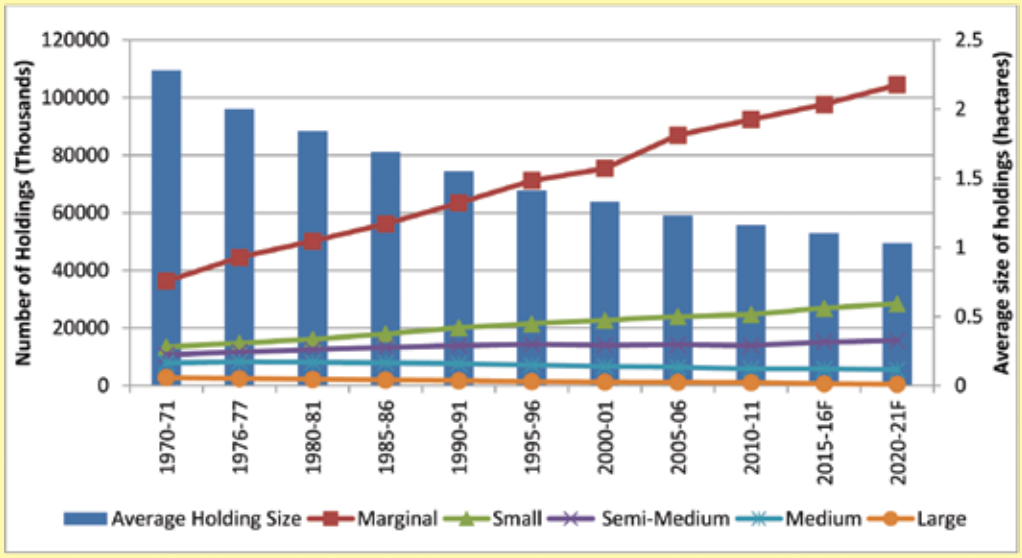


Despite this, however, its significance in sustaining India's growth momentum is expected to remain unchanged.

I.1.2 Shrinking Farm Size

A major challenge facing Indian agriculture is that the average-farm holding size is shrinking with the average farm size in 2010-11 estimated at 1.16 hectares[1] compared to 1.23 hectares in 2005-06, and 2.28 hectares in 1970-71. The number of marginal and small holdings (2 hectares and less) shows a continuous increase whereas medium and large holdings (4 hectares and above) show a steady downtrend. The total number of farm holdings has almost doubled from 71 million in 1970-71 to 137.8 million in 2010-11. If this trend continues, farm holdings in 2020-21 would number around 154 million with small and marginal holdings accounting for almost 85 per cent of total holdings and the average holding size projected to decline to just one hectare (**Figure I.2**).

Figure I.2: Indian Farm Holding Size Shrinking



Source: Data from the Directorate of Economics & Statistice, Ministry of Agriculture; extrapolations beyond 2010-11 are based on trend growth in each variable between 1970-71 and 2010-11.

Although the increasing number of small and marginal holdings does not directly imply a negative impact on agricultural productivity, it will have some significant implications for the economy, which include the following.

- Farm population per hectare of operated area will increase and per capita farm income will decline.
- Delivering agricultural credit to an increasing number of small and marginal farmers will pose a challenge and implementation of crop insurance at farm-holding level will become difficult.
- Farm mechanisation will become difficult unless there is pooling of farm land or joint use of machinery across farms.
- The marketable surplus of agricultural produce will decline with continued increase in on-farm consumption.

[1]Agricultural Census 2010-11 (http://agcensus.nic.in/document/agcensus2010/agcen2010rep.htm)

- Sourcing of agricultural produce for processing and retailing will become difficult as marketable surplus will become more fragmented making grading and standardisation difficult.

The key to offset the disadvantages of declining farm size would be higher productivity per hectare of crop area.

I.1.3 Changes in Cropping Pattern

Total planted area under major crops (foodgrains, oilseeds, cotton, sugarcane) has increased by around 7 per cent since 2000-01 to 176 million hectares in 2013-14, reflecting increased irrigarion availability leading to increased cropping intensity (**TableI.1**).

Most of the increase in cropped area during the past decade was in wheat, maize, soybeans, pulses and cotton with most of the decline coming from coarse grains (excluding maize), which has declined by 5 to 6 million hectares. Area under rice and sugarcane has remained more or less unchanged, except for some year-to-year variations. The increase in cotton area occurred in recent years coinciding with the introduction of Bt cotton. The area under pulses was stagnant between 2003-04 and 2009-10 and increased in the past two years with rising prices, leading to higher production and support from programmes such as the National Food Security Mission (NFSM).

The emerging scenario points to the dominance of wheat, cotton, soybeans, and maize in India's overall cropping pattern and the declining importance of coarse grains (excluding maize). The share of rice in total cropped area has also declined. We assume this trend in cropping pattern will continue. The continuation of trends, however, will be affected by constraints such as suitability of soil and climatic conditions, availability of irrigation and changing input availability.

Table I.1: Trends in Crop Area (million hectares)

Crops	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Rice	44.7	44.9	41.2	42.6	41.9	43.7	43.8	43.9	45.5	41.9	42.9	44.4	42.8	43.9
Wheat	25.7	26.3	25.2	26.6	26.4	26.5	28	28	27.8	28.5	29.1	29.9	30.0	31.2
Maize	6.6	6.6	6.6	7.3	7.4	7.6	7.9	8.1	8.2	8.3	8.6	8.8	8.7	9.4
Other Cereals	23.7	22.9	20.4	23.5	21.6	21.5	20.8	20.4	19.3	19.4	19.7	17.6	16.1	16.3
Pulses	20.4	22	20.5	23.5	22.8	22.4	23.2	23.6	22.1	23.3	26.4	24.5	23.3	25.2
Groundnut	6.6	6.2	5.9	6	6.6	6.7	5.6	6.3	6.2	5.5	5.9	5.3	4.7	5.5
Soybean	6.4	6.3	6.1	6.6	7.6	7.7	8.3	8.9	9.5	9.7	9.6	10.1	10.8	12.2
Rapeseed/ mustard	4.5	5.1	4.5	5.4	7.3	7.3	6.8	5.8	6.3	5.6	6.9	5.9	6.4	6.7
Other Oilseeds	11.9	11.2	10.8	11.7	12.6	12.9	11.4	12	11.8	10.6	z	10.3	9.3	9.6
Sugarcane	4.3	4.4	4.5	3.9	3.7	4.2	5.2	5.1	4.4	4.2	4.9	5.0	5.0	5.0
Cotton	8.5	9.1	7.7	7.6	8.8	8.7	9.1	9.4	9.4	10.1	11.2	12.2	12.0	11.7

Source: Directorate of Economics and Statistics, Department of Agriculture and Cooperation.

Note: "Other oilseeds" = Total 9 major oilseeds – rapeseed and mustard – soybean – groundnut; "Other cereals" = Total cereals – rice – wheat – maize; data for 2011-12 are 4th Advance Estimates.

The emerging scenario points to the dominance of wheat, cotton, soybeans, and maize in India's overall cropping pattern and the declining importance of coarse grains (excluding maize).

I.1.4 Trade Performance

India has an inherent competitive advantage in agricultural production due to its varied agro-climatic conditions. India is among the 15 leading exporters of agricultural products in the world. As per WTO's Trade Statistics, India's share in agricultural export and import in the world were 2.69 per cent and 1.31 per cent respectively in 2013.

India's share in agricultural export and import in the world were 2.69 per cent and 1.31 per cent respectively in 2013.

The country has emerged as a significant exporter of certain agricultural items like cotton, rice, meat, oil meals, pepper and sugar. India has developed export competitiveness in certain specialised agriculture products like basmati rice, guar gum and castor oil. Agricultural exports, which constituted 12.16 per cent of India's total exports in 2014-15, have increased from Rs. 28,756 crore in 2001-02 to Rs. 2,19,900 crore in 2012-13 and further to Rs. 2,29,996 crore in 2014-15. The increase in the value of agricultural exports between 2012 and 2015 was primarily on account of higher exports of marine products, basmati and non-basmati rice, meat and meat preparations, cotton, oil meal, spices and guar gum. On the other hand, India's agricultural imports, which accounted for 4.47 percent of India's total imports in 2014-15, have increased from Rs. 16,257 crore in 2001-02 to Rs. 1,03,693 crores in 2012-13 and further to Rs 1,22,188 crores in 2014-15, registering a growth of nearly 17.8 per cent between 2012 and 2015. The increase in the value of agricultural imports during this period was primarily on account of the import of vegetable oils, pulses, cashew nuts, spices, sugar and cotton. The major agriculture commodities imported by India during recent three years are vegetable oil, pulses, wood and wood products, fruits, cashew, spics, sugar etc. However, despite this, a major issue of concern in recent years is the decline in the share of agricultural exports in total exports from 13.5 per cent in 2012-13 to 12.2 per cent in 2014-15, and the rise in the share of agricultural imports in total imports from 3.9 per cent in 2012-13 to 4.5 per cent in 2014-15.

A major issue of concern in recent years is the decline in the share of agricultural exports in total exports from 13.5 per cent in 2012-13 to 12.2 per cent in 2014-15, and the rise in the share of agricultural imports in total imports from 3.9 per cent in 2012-13 to 4.5 per cent in 2014-15.

A recent report of the working group set up by the Ministry of Agriculture and headed by Prof. Mahendra Dev, has undertaken a comprehensive exercise of constructing year-wise indices of prices received (IPR) by farmers. This study uses a more comprehensive method to assess the terms of trade between the agricultural and non-agricultural sectors, a key indicator that guides the government's agricultural price policies. The concept of terms of trade (TOT) between the agricultural and non-agriculture sectors is calculated as the ratio between the combined indices of prices received to the combined index of prices paid by the farming community for final consumption, intermediate consumption and capital formation. The new methodology includes labour services in the list of goods and services sold by agriculture to non-agriculture. Because the agriculture population consists of both farmers and agricultural labourers, the report gives two separate indices of terms of trade for farmers and aggregate agriculture, where the latter comprises both farmers and agricultural labourers.

The findings of the study reveal that ToT for farmers and the agricultural sector improved rapidly between 2004-05 and 2010-11, after which they remained stable until 2013-14. The reasons for the increase in ToT for farmers between 2004–05 and 2010–11 are significant increases in the minimum support price and in global agricultural prices. Food inflation was also high during this period as compared to the rise in prices of non-food articles. The reasons for the rise in ToT for the agriculture sector are the same as those for farmers. However, according to the report, the terms of trade for agriculture rose much faster than for farmers (**Table I.2**), because the rise in wages for agricultural labourers in non-agricultural activities during this period tilted the terms of trade much more for agriculture as a whole than for farmers. The terms of trade rose

from 81.56 in 2004–05 to 102.89 in 2010–11, improving by 26 per cent for agriculture sector as a whole compared to 17 per cent for the farm sector. It seems the agriculture sector benefited more than the non-agricultural sector, as wage earnings showed higher growth. Better terms of trade along with increases in productivity are important for raising the incomes of farmers and the agricultural sector.

Table I.2: Index of Terms of Trade (ToT)

Year	Farmers Index for ToT	Aggregate Agriculture Index for ToT
2004-05	87.82	81.53
2005-06	84.80	79.82
2006-07	87.06	82.82
2007-08	92.20	86.74
2008-09	99.98	93.86
2009-10	100.15	98.35
2010-11	102.95	102.89
2011-12	97.26	98.79
2012-13	97.34	100.91
2013-14* (P)	95.55	99.13

*Provisional
Source: S. Mahendra Dev and N Chandrasekhara Rao, EPW Weekly, April 11, 2015, Vol. 1. No. 15.

I.2 Recent Government Initiatives

In the last one year, the new government has injected different perspectives to many conventional models in which India operated, including in Agriculture Sector[2]. Indian agriculture is typically dependent on the summer monsoon rains, making it vulnerable to the vagaries of weather. In a bid to remove persistent bottlenecks in Indian agriculture and revive growth, the government recently approved a Rs.50,000 crore irrigation package under the Pradhan Mantri Krishi Sinchai Yojana (PMKSY).[3] The scheme will also promote precision-irrigation technologies, enhance recharge of aquifers and introduce sustainable water conservation practices. This flagship irrigation scheme, when implemented, will ensure that all farm lands get water for cultivation, reducing the dependency of Indian agriculture on the monsoon and reducing the year-to-year yield fluctuations.

The government recently approved a Rs.50,000 crore irrigation package under the Pradhan Mantri Krishi Sinchai Yojana (PMKSY).

Another bottleneck facing Indian agriculture is a non-transparent agricultural marketing system, which prevents fair price realisation by farmers, mainly because of market rigidities. It also leads to wide intra-regional price disparities and wide price fluctuations. To address this issue, the government also recently took the first step to create a national market for agricultural produce through an electronic platform. This will provide farmers and traders with access to opportunities for purchase and sale of agricultural commodities in a transparent manner. It would also increase farmers' access to markets through warehouse-based sales and thus obviate the need for a farmer to transport his produce to a *mandi*.

The government also recently took the first step to create a national market for agricultural produce through an electronic platform.

[2]Public-private tie-ups are key to boosting agri infra (http://www.thehindubusinessline.com/news/variety/publicprivate-tieups-are-key-to-boosting-agri-infra/article7371470.ece)

[3]http://pib.nic.in/newsite/PrintRelease.aspx

The government is also reconsidering its role in the management of the food economy. One indicator of this has been the formation of a high-level committee to redefine the roles and functions of the Food Corporation of India (FCI), the major government parastatal involved in procurement, warehousing, transportation and distribution of food grains, mainly wheat and rice. As per the recommendation of the committee, which submitted its report to the government in January 2015[4], the government is also considering direct cash transfers to the Aadhaar-linked bank accounts of public distribution system (PDS) beneficiaries.

Although private participation in agriculture has shown some growth, it has remained limited. The existing lack of agriculture infrastructure, such as storage, processing, cold chains and logistics calls for increased private or public-private participation in these areas. The government has played a vital role of encouraging/aggregating private investment with announcements of various policy level decisions and projects such as setting up mini-food parks. However, foreign direct investment in food retailing continues to remain a contentious issue. The primary goal of developing agricultural infrastructure is to provide facilities along the value chain from the farm to the table. Such infrastructure is also likely to promote organised contract farming in the catchment areas, moderating to some extent the negative impact of shrinking size of farm holdings in India.

The primary goal of developing agricultural infrastructure is to provide facilities along the value chain from the farm to the table.

[4] http://www.fci.gov.in/upload/News/Report%20of%20the%20High%20Level%20Committee%20on%20Reorienting%20the%20Role%20and%20Restructuring%20of%20FCI_English.pdf

CHAPTER II

Global Food Commodity Outlook

II.1 Introduction to Global Outlook

Medium agricultural outlooks present an assessment of the key dimensions of emerging agricultural scenario in the next 5-10 years. They provide a description of the emerging scenario with respect to production, consumption, trade, per capita consumption and prices, globally and for some specific countries. Some models like the one by OECD/FAO gives area and yield projections by commodities. The projections of future scenarios generally are based on normal or average weather and macroeconomic conditions and assume that current agricultural and trade policy will remain in force during the projection period.

Three institutions project the medium-term global agricultural outlook every year: OECD-FAO[5], USDA[6] and FAPRI[7] (the latest available FAPRI report is 2011 but data projection was updated in 2012). This year, the International Grain Council (IGC) has also made a five-year (up to 2019/20) outlook projection for major grain and oilseed crop[8]. In this report, we have used the latest available detailed medium-term projections by these agencies as a reference scenario in the global context with special focus on India. A standalone model projection for Indian agriculture using the OECD/FAO developed COSIMO Model has also been applied by NCAER for medium-term projection.

The goal of this comparison report is not to highlight absolute projection values, which could differ based on different assumptions and model structures, but to focus on highlighting common and diverging trends across projections as well as identifying uncertainties that could significantly affect markets. Hence we have quoted profusely from these reports with due acknowledgement.

II.2 Major Medium-term Outlook Models[9]

a) OECD-FAO Outlook for World Agricultural Commodity Markets

The OECD-FAO annual Agricultural Outlook is prepared jointly by the Organization for Economic Co-operation and Development (OECD) and the Food and Agriculture Organization (FAO) of the United Nations. The Agricultural Outlook provides a

[5]OECD-FAO Agricultural Outlook 2014-2023
available at www.oecd.org/site/oecd-faoagriculturaloutlook/

[6]USDA Agricultural Projections to 2023, published in February 2014 available at
http://www.ers.usda.gov/media/1279470/oce141.pdf
http://www.ers.usda.gov/data-products/international-baseline-data.aspx#45167

[7]FAPRI-ISU 2011 World Agricultural Outlook, published in April 2011
available at http://www.fapri.iastate.edu/outlook/2012/

[8]http://www.igc.int/en/downloads/grainsupdate/igc_5yrprojections2014.pdf

[9]We have referred to http://www.ilr.uni-bonn.de/agpo/rsrch/capri-rd/docs/d4.1.pdf for comparison of the three models and some regional models.

baseline for further analysis of alternative economic or policy assumptions. Markets for cereals, oilseeds, sugar, meats, dairy products and bio-fuels are covered.

The methodological approach involves a set of assumptions on exogenous and policy-related drivers, a collaborative expert system and a joint modelling system that ensures the consistency of the projections.

The Outlook brings together the commodity, policy and country expertise of OECD and FAO, providing an assessment of agricultural market prospects for production, consumption, trade, stocks and prices of commodities that include wheat, rice, coarse grains, oilseeds and products, sugar, dairy products and meat, besides bio-fuel.

A jointly developed modelling system, based on the OECD's Ag-link (a recursive-dynamic, partial equilibrium, supply-demand model of world agriculture) and FAO's COSIMO models, provides the analytical framework for the projections. The new model component is termed COSIMO (Commodity Simulation Model). The general programming structure of COSIMO was taken over from Ag-link, while the behavioural parameters for the new country modules were taken from its predecessor at the FAO, the World Food Model.

b) USDA Agricultural Outlook

The Economic Research Service (ERS) of the United States Department of Agriculture (USDA) prepares a set of 10-year projections for the US and world agricultural commodity markets. The commodity coverage is focused on such products for which US government support programmes exist and on trade. The 10-year USDA baseline is developed using a composite of models and analysis of other available information. The baseline is based on specific assumptions regarding macroeconomic conditions, policy, weather and international developments. A set of economic models is used as a starting point for generating the baseline projections:

- A domestic crop-area allocation model
- A number of US commodity market models
- A US agricultural sector model, the Food and Agricultural Policy Simulator (FAPSIM), to analyse detailed technical and policy options. FAPSIM is an annual agricultural sector model, covering major US crop and livestock commodities.
- A global agricultural trade model, "Country-Commodity Linked Modelling System" that links 24 commodity markets in 39 countries/regions, to cover global agricultural markets. Projections cover production, demand and trade for agricultural commodities, as well as aggregate indicators on the sector, such as farm income.

c) FAPRI Projections for Agricultural Markets

The Food and Agricultural Policy Research Institute (FAPRI), housed jointly at Iowa State University and the University of Missouri, Columbia, prepares a multi-year baseline projections every year for the US and world agricultural markets. The results of the FAPRI baseline are published yearly in the FAPRI US and World Agricultural Outlook, which is intended to serve as the point of comparison for evaluating alternative policy scenarios. The FAPRI baseline is prepared using comprehensive data, a computer modelling system and an expert review process. The model FAPRI uses to develop the

baseline contains over 3,000 equations representing supply and demand relationships in the United States and major countries around the world, and consists of a set of partial equilibrium models, covering the US crops model, as well as the international cotton, dairy, livestock, oilseeds, rice, and sugar models. The commodity models are largely independent with some linkages with each other.

Because of budget constraints, FAPRI did not develop a joint 2012 baseline with colleagues at the University of Missouri or other institutions. However, FAPRI-ISU developed a separate Outlook, available as the FAPRI-ISU 2012 World Agricultural Outlook, which is the latest. Due to budget cuts, the annual World Agricultural Outlook has been discontinued.

d) International Grains Council: Five-year Global Supply and Demand Projections

The projection covers wheat, rice, maize (corn), jowar (sorghum), barley, oats and rye, soybeans, and rapeseed/canola. Details about the type of model used and outlook assumptions used by IGC are not available in the public domain.

II.3 Comparison of the Medium-term Projections[10]

The projections using these models differ to some extent due to the assumptions made regarding various macroeconomic variables such as GDP growth, currency exchange rate, population, weather, international developments and agriculture and other country specific policy variables. Furthermore, the growth rates for various parameters such as production, consumption, trade, end-stocks, per capita consumption and prices (both global and India specific) calculated by us using these model projections are not comparable in absolute terms and are only indicative as the commodity coverage and projection period are different for various agencies. This is broadly summarised in **Table II.1**.

Table II.1: Commodity Coverage and projection period by various agencies

Agency Commodity Coverage (Global)	FAO/OECD	ERS/USDA	FAPRI	IGC
Grains	Wheat, rice, total coarse grains (breakup not given),	Wheat, rice, coarse grains (maize, jowar, barley)	Wheat, coarse grains (maize, jowar, barley)	Wheat, rice, coarse grains (maize, barley, sorghum, rye, oats, other coarse grains)
Oilseeds	Total oilseeds (breakup not given)	Only soybean	Only soybean	Soybean + Rapeseed
Vegetable oils	Total vegetable oils (breakup not given)	Only soybean oil	Only soybean oil	NA
Sugar	White sugar	NA	White Sugar	NA
Projection Period	2013 to 2023 (11 years)	2013 to 2023 (11 years)	2013-2021 (9 years)	2013-2019 (7 years)

[10]A detailed report on the comparison and contrast of the projections by the three agencies is available in Agricultural Commodity Markets Outlook 2011-20 :http://ec.europa.eu/agriculture/analysis/tradepol/worldmarkets/outlook/2011_2020_en.pdf

Projection conclusions by USDA, FAPRI, and IGC are generally in agreement with the FAO/ OECD projection conclusions

Regarding prices, only FAO gives domestic (India) price projections in rupees, probably in real terms. The commodity whose price is referred to and whether the prices are the farm prices, wholesale prices or retail price is not clear in the FAO/OECD projections. It is unclear for which market and which grade of coarse grains, oilseeds, and oil the international prices quoted by FAO refer to. FAPRI price projections for soybean are CIF Rotterdam while its soy oil price projections are for Rotterdam (FOB).

However, projection conclusions by USDA, FAPRI, and IGC are generally in agreement with the FAO/OECD projection conclusions listed below:

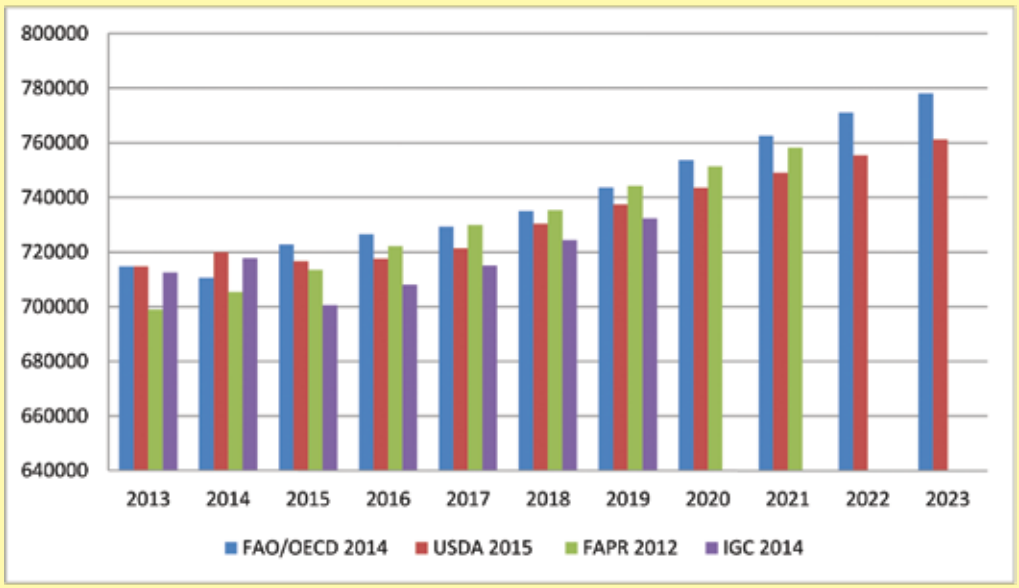
- The potential for area expansion in the next decade is weak for most crops and production and growth will mostly be driven by yield increases
- Demand for agricultural products is expected to remain firm although it is expected to expand at slower rates as compared to the past decade.
- Growing incomes, urbanisation and change in eating habits are likely to contribute to the transition to diets with protein, fat and sugar content, both globally and in India.
- Prompted by increasing demand for livestock and bio-fuels, there is likely to be a shift in cropping pattern globally, favouring coarse grains at the cost of wheat and rice.
- Crop prices are expected to drop during the next couple of years globally before stabilising at levels that remain above the pre-2008 period. However, in India prices are likely to firm up for all commodities in rupee terms.
- The expected improved stocks-to-use ratio for cereals should alleviate concerns about their price volatility.

We have discussed the highlights of the global assessments by commodity and by agencies below.

II.3.1 Wheat

II.3.1.a Production

Figure II.1: Global Wheat Production (Thousand Metric Tonnes)



OECD\FAO

World wheat production is projected to reach 778 million tonnes by 2023, about 12 per cent higher than in the base period (average of 2011-13). This represents an annual growth rate of about 1 per cent compared to 1.5 per cent in the previous decade. The reason for this sharp deceleration is the stabilisation of land use for wheat production over the outlook period. The potential for area expansion in the next decade is weak for cereals and production and growth will mostly be driven by yield increases. While the accumulated yield growth for the outlook versus the base period is projected at 10 per cent, the increase in crop land devoted to wheat is less than 3 per cent. Despite an unstable production trend, the Russian Federation is expected to further increase production, with Ukraine projected to lead the production growth.

USDA

World wheat production is projected to reach 761 million tonnes by 2023, 9 per cent higher than in the base period.

FAPRI

Global wheat production is projected to reach 758 million tonnes by 2021.

IGC

Production growth is not expected to be as strong in the next five years. While world wheat production is expected to increase over the five years to 732 million tonnes in **2019/20** (the latest year for which IGC projections are available), annual gains in wheat production are seen lagging those of recently. Yields in some countries may not match the exceptional levels of the 2013/14 and 2014/15 seasons, although the global average is expected to edge higher. Furthermore, given continued competition from other crops, any increase in wheat planted areas will likely be marginal. Thereafter, only a modest gain in world wheat planted area is anticipated, constrained by competition from other crops, especially maize and oilseeds. Area expansion in the Commonwealth of Independent States (CIS) moderately exceeds the pace in other major growing regions, bolstered by rising local feed needs as well as export demand. Argentina is also expected to increase sowing of wheat at a comparatively faster rate than elsewhere, recouping some of the decline of recent years.

After falling by about 3 per cent in 2015/16 from the high level in the previous season, average world yields are projected to resume an upward trend in the remainder of the period, increasing by roughly 1 per cent annually. Together with a small rise in area, production is expected to surpass the current year's record by 2018/19 and reach 732 million tonnes in the following season, a 2 per cent net gain compared with 2014/15.

II.3.1.b Consumption

FAO/OECD

World wheat consumption for food, feed, and industrial usage is projected at 773 million tonnes by 2023, with per capita annual human consumption remaining steady at around at 65 kg. Feed use of wheat is projected at 154 million tonnes, growing at a

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World wheat consumption for food, feed, and industrial usage is projected at 773 million tonnes by 2023, with per capita annual human consumption remaining steady at around at 65 kg.

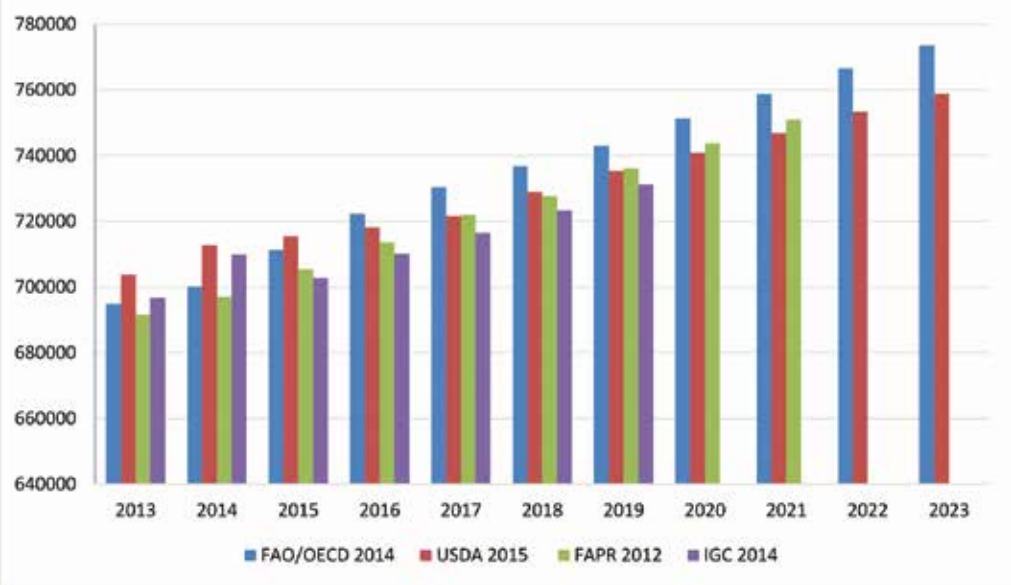
The main factors that contribute to the rapid increase in developing countries' demand are their high population and income growth rates, accompanied by increased urbanisation and expansion of the middle class.

slightly slower pace than in the past, representing 20 per cent of total use. Wheat use for bio-fuels in developed countries is projected at 2.1 per cent, up from the base period 0.9 per cent, with most of the increase in EU.

USDA

USDA projects world wheat consumption to reach 759 million tonnes by 2023/24, close to the FAO/OECD projection. Low- and middle-income countries are projected to account for a large proportion of the increase in world grain consumption in general and wheat consumption in particular over the next decade. In the projection, over 95 per cent of the increase in grain consumption occurs in these countries. The main factors that contribute to the rapid increase in developing countries' demand are their high population and income growth rates, accompanied by increased urbanisation and expansion of the middle class.

Figure II.2: Global Wheat Consumption (Thousand Metric Tonnes)



FAPRI

FAPRI projects world wheat consumption to reach around 751 million tonnes, with 7 per cent growth in food use at 606 million tonnes, lagging behind the 15 per cent growth in feed use projected at 145 million tonnes during the projection period (2013/14 to 2021/22).

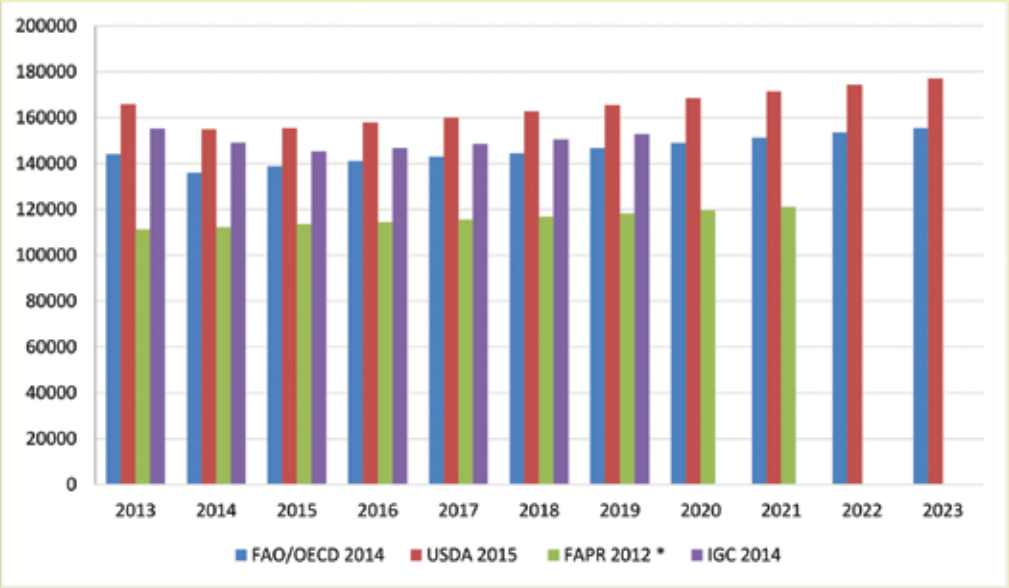
IGC

IGC projects world wheat consumption to reach 731 million tonnes by 2019/20. Consumption growth is expected to be somewhat slower than growth registered recently. Projected increases in demand almost entirely come from higher use for human food, seen broadly matching recent population rates of growth. With a comfortable outlook for global maize supply and demand, feed use of wheat is expected to stabilise at a

slightly lower level than in recent years. Use for industrial purposes is expected to stay small, with other grains, particularly maize, continuing to be favoured.

II.3.1.c Trade

Figure II.3: Global Wheat Trade (Thousand Metric Tonnes)



* Excluding interregional trade.

OECD\FAO

OECD/FAO forecasts world wheat trade to increase to 155.5 million tonnes by 2023 from 144.1 million tonnes in 2013. The United States and Canada are projected to be the major exporters in 2023 followed by the CIS countries, mainly the Russian Federation, Ukraine and Kazakhstan. Argentina is also expected to improve its share of international wheat markets.

USDA

World wheat trade (which includes flour) is projected to expand by nearly 28 million tonnes (19 per cent) between 2014-15 and 2023-24, rising to 177 million tonnes. Growth in wheat imports is concentrated in those developing countries where income and population gains drive increases in demand. The largest growth markets include the 15 countries of the Economic Community of West African States, other Sub-Saharan African countries, Egypt, other countries in the North African and the Middle East region, Indonesia, and Pakistan.

In many developing countries, almost no change in per capita wheat consumption is expected, but imports are projected to expand modestly because of population growth and limited potential to expand wheat production.

OECD/FAO forecasts world wheat trade to increase to 155.5 million tonnes by 2023 from 144.1 million tonnes in 2013.

The largest growth markets include the 15 countries of the Economic Community of West African States, other Sub-Saharan African countries, Egypt, other countries in the North African and the Middle East region, Indonesia, and Pakistan.

Egypt is expected to remain the world's largest wheat-importing country, with imports climbing to 12 million tonnes by 2023-24. Imports by Indonesia are also projected to grow rapidly to nearly 10 million tonnes and it is expected to replace Brazil as the second-largest wheat importing country. Imports by Vietnam and Bangladesh are both projected to rise rapidly. Imports by countries in Africa and the Middle East are expected to rise by 14 million tonnes and account for half of the total increase in world wheat trade.

The five largest traditional wheat exporters (the United States, Australia, the EU, Argentina, and Canada) are expected to account for a major share (60 per cent) of world trade in 2023-24 although this is somewhat lower than the nearly 70 per cent they accounted for in the last decade. The reduction in their share can be attributed to increased exports from the Former Soviet Union (FSU). Little change is projected for Canadian wheat exports. The EU is the only traditional exporter whose market share is projected to increase and surpass 30 million tonnes by 2023-24, due to larger availability at lower prices of other preferred feed grains such as maize and barley. .

The upward trend in wheat exports from Russia, Ukraine, and Kazakhstan, which were hit by droughts in 2010 and 2012, are expected to recover and rise more than 50 per cent to reach 52 million tonnes by 2023-24, about two-thirds of the projected increase in world wheat trade. Continued year-to-year volatility in wheat production and trade from this region is likely because of fluctuating yields resulting from weather variations.

FAPRI

Net wheat trade (excluding inter-regional trade) is projected to reach 121 million tonnes in 2021-22, an increase of 9 per cent over 2013-14. Net wheat imports by Asian countries are projected to increase by around 1.2 million tonnes over the next 15 years. African countries are expected to increase their net imports by 13.5 million tonnes during this period. The US market share is projected to decline to 15.4 per cent by 2025-26 because of strong competition from other exporting countries. China and India are expected to remain net exporters of wheat.

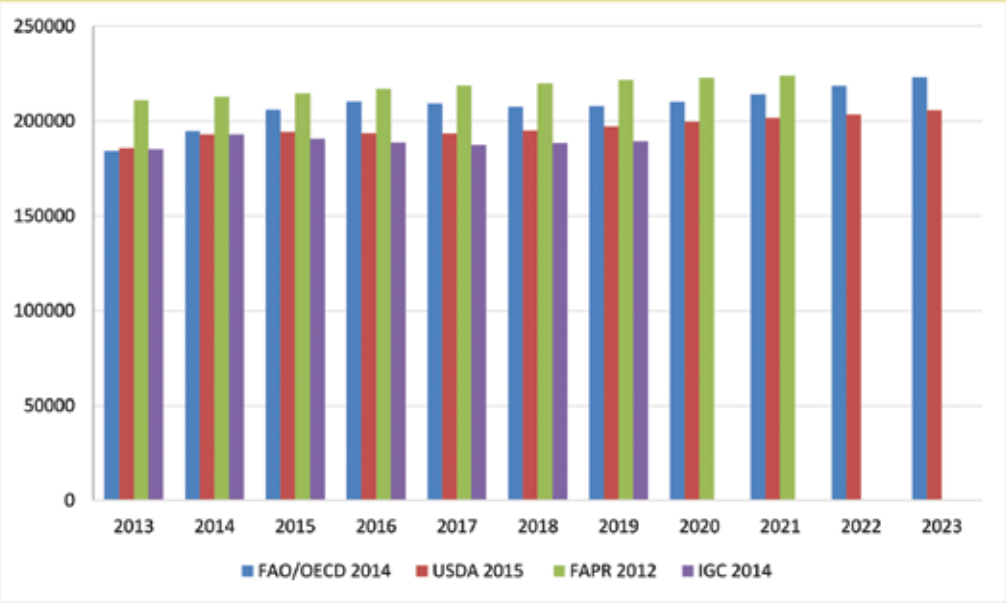
IGC

Although annual trade volumes are projected to be less than the 2013-14 record, world wheat trade is nevertheless expected to increase over the next five years. A modest decline is projected in 2015-16, and thereafter, global trade is expected to grow by about 1.3 per cent per annum, mostly on higher demand for milling wheat in Asia and Africa. Trade in wheat used as feed may also increase, but volumes are likely to be contained by the ample availability of alternatives, particularly maize. Black Sea region exporters are projected to further increase their share of global trade. Egypt is expected to remain the world's largest importer. While production in India is forecast to maintain an increase,

gains may not keep pace with accelerating demand and small imports are projected. The US is projected to be the single largest exporter for most of the period, but its overall share of global trade is likely to be eroded by competition from other countries.

II.3.1.d Stocks

Figure II.4: Global Wheat Stocks (Thousand Metric Tonnes)



OECD/FAO

World ending stocks of wheat are projected to follow a somewhat cyclical trend, increasing from 184 million tonnes in 2013 to 210 million tonnes in 2016 due to bumper harvests, and thereafter, steadily declining to 207 million tonnes in 2018 before increasing to 223 million tonnes in 2023.

USDA

Stocks are projected at 206 million tonnes by 2023, a slight increase over the projected period, mostly in CIS countries. Stocks-to-use ratio in major exporting countries is projected at 32 per cent, slightly lower than the base period.

FAPRI

With a steady increase, world ending stocks of wheat are projected at 224 million tonnes in 2021-22 from 211 million tonnes in 2013-14.

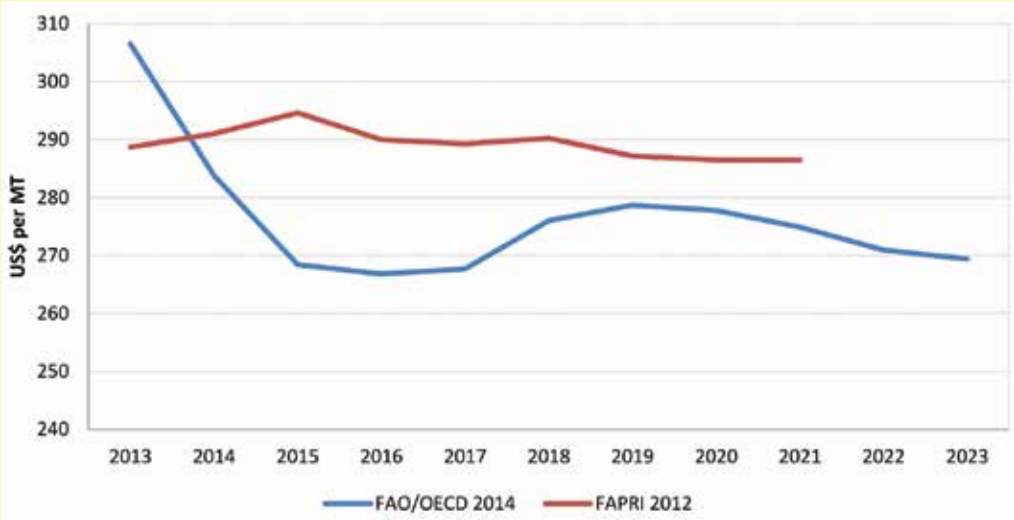
IGC

World stocks (aggregate of respective local marketing years) are expected to show a small net decline over the next five seasons, retreating from the four-year high anticipated at the end of 2014-15. A rise in consumption is likely to lead to a tightening of the global stocks-to-use ratio marginally to 26 per cent, comfortably above the recent low of 22

per cent in 2007-08. After an expected significant increase following large harvests in 2014-15, combined inventories in the eight major exporters are seen modestly lower, with those in the EU and Black Sea region returning to more normal levels. Carryover stocks elsewhere are projected to remain comfortable. While China's inventories continue to increase, stocks in India are projected to show little change, staying above the government's minimum desired level.

II.3.1.e Price

Figure II.5: Global Wheat Price



Cereal prices in general and wheat prices in particular are projected to decrease, mainly influenced by a slower economic growth and strong recovery in world grain supply after the 2012 droughts in the United States and CIS countries.

OECD/FAO

Cereal prices in general and wheat prices in particular are projected to decrease, mainly influenced by a slower economic growth and strong recovery in world grain supply after the 2012 droughts in the United States and CIS countries. Wheat prices are projected to approach US$ 270 per tonne in nominal terms by 2023, starting at US$ 284 per tonne in 2014, the lowest levels since 2010. In the first three years of the outlook period, wheat prices will decrease due to ample production prospects in the US, Canada, and Brazil reaching US$ 267 per tonne

USDA

Although USDA has not projected global wheat prices, US wheat prices are projected to decline through 2016-17, reflecting rising wheat stocks and falling corn prices. This is somewhat at variance with OECD projection. Wheat prices increase through the remainder of projection period with export growth, moderate gains in food use, and declining stocks.

FAPRI

Somewhat similar to USDA projection, world wheat price is projected to increase and then to decline to $287 per metric tonne (US FOB Gulf) in 2021-22. Australian and Canadian wheat export prices are also projected to follow a similar pattern.

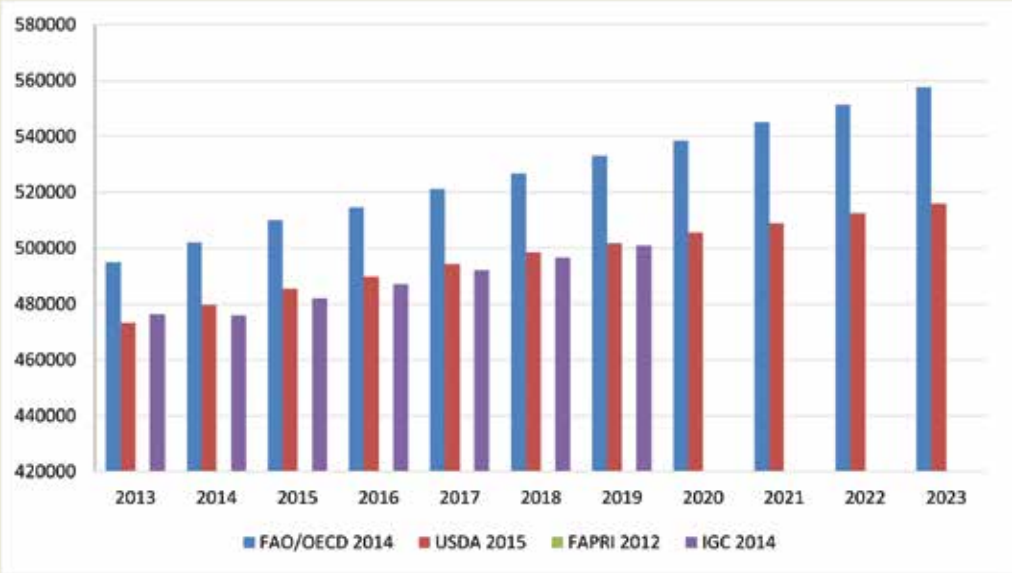
IGC

IGC has not made a projection of global wheat prices.

II.3.2 Rice

II.3.2.a Production

Figure II.6: Global Rice Production (Thousand Metric Tonnes)



Note: It has been noticed that OECD/FAO projections of rice production, consumption, and stocks are significantly above projections by USDA and IGC, perhaps due to the difference in coverage of countries. However, rice trade projections by all the three agencies converge.

OECD/FAO

Global rice production is projected to expand at a projected growth rate of 1.2 per cent per annum, about half the 2.2 per cent recorded in the previous ten years, to touch 558 million tonnes in 2023, with virtually all the expected increase in production stemming from yield gains rather than area expansion. Much of the area expansion will be in the developing countries of Africa and Asia such as Cambodia and Myanmar, where there is further scope for increasing area and irrigation coverage. Output in China is also keep rising, albeit modestly, with the objective of achieving the declared self-sufficiency. Uncertainly about Thailand government's rice procurement policy could have a negative impact on production in the short-term. In the medium-term, however, there is still considerable room for improvement in yields and productivity gains will contribute to steady growth in production.

USDA

Global rice production is forecast at 516 million tonnes by 2023, an increase of 9 per cent over 2013, with most of the increase in Asia.

Global rice production is projected to expand at a projected growth rate of 1.2 per cent per annum, about half the 2.2 per cent recorded in the previous ten years, to touch 558 million tonnes in 2023.

FAPRI

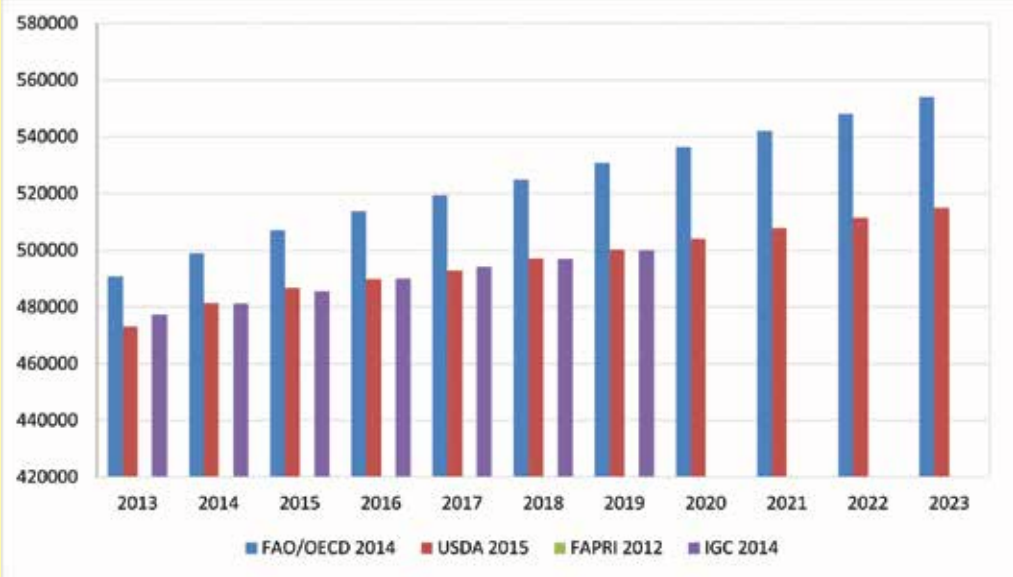
FAPRI projections do not cover rice.

IGC

Global rice output is expected to increase in the five years to 2019-20 to 501 million tonnes, close to the USDA forecast. This will be because of increased production in Asia, together with a marginal rise in production in other regions. However, the rate of growth will be slower than in the past amid expectations of a less pronounced expansion in China, the world's biggest producer. With rice planting seen rising only fractionally, higher production will mainly be driven by yield improvements. The global paddy area is projected to increase only fractionally, albeit to a record of 162.4 million hectares by 2019-20. Sowings are set to expand moderately in India and other parts of Asia, with a slower rate of growth for the region as whole due to an expected contraction in China. After peaking in 2016-17, seeding there is projected to fall back to around 30 million hectares by 2019-20. Consequently, yield gains will be more important. Continuing efforts to boost production and reduce import dependence is likely to contribute to productivity improvements in Asia and Africa. The latter region appears to hold the greatest potential for productivity enhancements, but this rests on the adoption of improved farming practices and higher investment.

II.3.2.b Consumption

Figure II.7: Global Rice Consumption (Thousand Metric Tonnes)



Sustained by the demand for rice as food, the total utilisation of rice is expected to expand by about 1.1 per cent per annum to around 554 million tonnes in 2023.

OECD/FAO

Sustained by the demand for rice as food, the total utilisation of rice is expected to expand by about 1.1 per cent per annum to around 554 million tonnes in 2023. In Asia, where much of the rice produced is consumed domestically, per capita rice consumption is expected to rise only marginally, as diets diversify. On the other hand, per capita consumption will keep growing in African countries, where rice is gaining relative importance as a major food staple.

USDA

USDA projects global rice consumption to increase to 515 million tonnes in 2023-24 from 473 million tonnes in 2013-14, significantly below the OECD/FAO projections. In Thailand and Vietnam, per capita consumption is expected to decline as rising incomes support a shift from rice toward a more diversified diet with increased meat consumption.

FAPRI

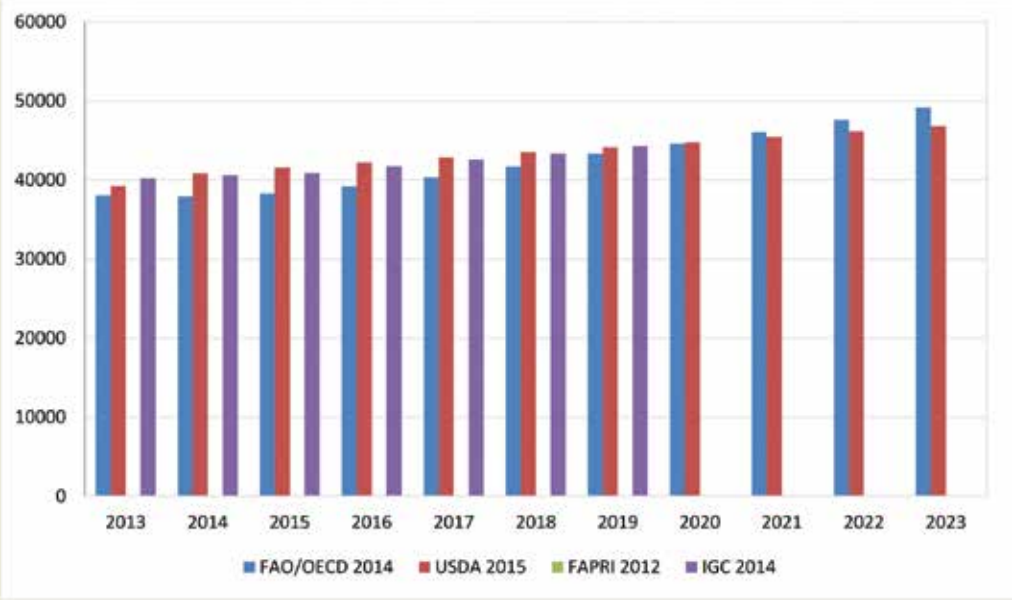
Rice is not covered under FAPRI projections.

IGC

World rice consumption is projected to expand at a decelerating rate over the medium term, reaching 500 million tonnes by 2019-20, close to the USDA projection, reflecting slower growth in Asia. At 0.8 per cent per annum, the projected annual average increase in global demand during the medium term compares to 1.9 per cent during the previous five-year period. Rising incomes in Asia, notably China, would prompt a shift to expanded protein demand at the expense of traditional staples, such as rice, as higher incomes prompt a shift to greater protein intake. In India, policy measures such as the implementation of the National Food Security Act (NFSA), which seeks to widen access to subsidised food grains including rice, will underpin rising consumption in coming years. Rice consumption in sub-Saharan Africa is likely to expand by slightly more than 2 per cent per annum over the medium term, with Nigeria remaining the largest market.

II.3.2.c Trade

Figure II.8: Global Rice Trade (Thousand Metric Tonnes)



A relatively fast pace of expansion of 3.1 per cent per annum is projected in the next ten years, which lifts the volume traded to 49 million tonnes by 2023.

OECD/FAO

Despite being a thin market, compared with other agricultural commodities, international rice trade registered a particularly fast annual growth of 3.6 per cent in the past ten years. A relatively fast pace of expansion of 3.1 per cent per annum is projected in the next ten years, which lifts the volume traded to 49 million tonnes by 2023. All traditional exporters, including India, Pakistan, Thailand, Vietnam and the United States, are expected to increase their exports. Thailand, in particular, is foreseen to regain its leadership following relaxation of the high producer price policy applied in the past three years and on the back of large inventories held in public warehouses, which will take several years for the market to absorb. One of the factors likely to dominate developments in the next decade is the probable rise of Cambodia and Myanmar as major rice exporters, which would further stoke competition among rice producing countries.

USDA

World rice trade is projected at around 47 million tonnes during the projection period ending 2023. Thailand and Vietnam, typically the world's largest rice exporting countries, account for about 45 per cent of world rice exports in the coming decade. In Thailand, increasing production and a drawdown of large stocks should enable exports to rise by 2.4 million tonnes to 13.3 million tonnes by 2024-25. Vietnam's exports are projected to expand 2.1 million tonnes, rising from 6.8 million tonnes to almost 9.0 million tonnes over the projection period. Following the easing of export ban on non-basmati rice by the Indian government in September 2011, exports jumped, making India the leading rice exporter for several years. India is projected to be the second largest exporter through 2016-17 and then is projected to drop to third place behind Vietnam. India's exports are projected to increase after 2017-18, reaching 8.3 million tonnes.

Myanmar and Cambodia are projected to increase production over the next decade. Annual rice exports of Myanmar and Cambodia are projected at 1.6-1.8 million tonnes by 2024-25.

FAPRI

Rice not covered.

IGC

Global rice trade is seen reaching a record of 40.9 million tonnes in calendar 2015, driven by expanding shipments of white and parboiled varieties to markets in Far East Asia and sub-Saharan Africa. Exports are projected to reach 44.3 million tonnes in 2019, representing an annual average increase of 1.7 per cent during the next five years (compared to 5.5 per cent between 2010 and 2015). While shipments to Bangladesh, Indonesia and the Philippines, are expected to rise to meet domestic market needs, China's imports are forecast to contract significantly.

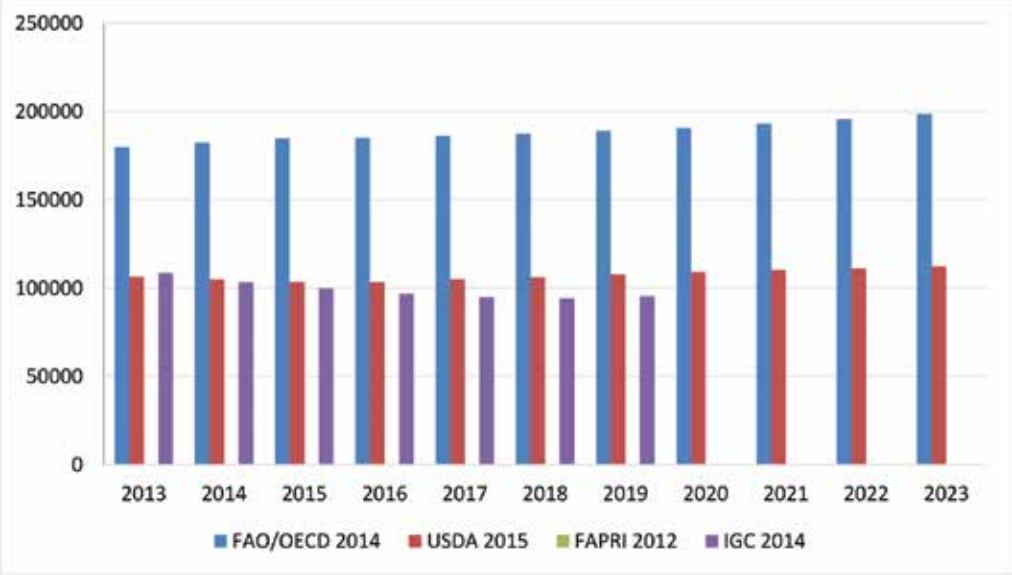
Thailand is likely to remain the world's top exporter throughout the medium term. Following the disbandment of the country's paddy mortgage scheme in early 2014, exports have surged on intensified efforts to release stocks and boost sales. Thailand's exports are projected to expand continuously over the medium term, albeit at a slower

pace, to reach 11.8 million tonnes by 2020. By contrast, India's exports are projected to fall to 7 million tonnes by 2020, with most of the decline in lower-quality varieties, with some increase in the traditional fragrant Basmati rice. Among other leading suppliers, sales by Vietnam, Pakistan and the US are expected to rise modestly.

The five main exporters mentioned above account for around 80 per cent of global shipments. Outside this grouping are a number of small to medium volume suppliers, mainly in South America and Far East Asia, especially Cambodia and Myanmar. Although Myanmar was the world's largest exporter in the early 1960s, underinvestment in the agricultural sector and limited access to foreign markets saw production and export volumes dwindle over much of the period since. For both Myanmar and Cambodia, the potential to export will hinge on the ability to tap into non-traditional markets, which will ultimately depend on improvements in quality and consistency. Shipments by Myanmar and Cambodia are projected to increase over the medium term, to reach around 2.0 million tonnes each by the end of the projection period.

II.3.2.d Stocks

Figure II.9: Global Rice End Stocks (Thousand Metric Tonnes)



OECD/FAO

The favourable outlook on supply allows for the rebuilding of grain stocks, including rice, which are projected to reach 199 million tonnes by 2023. China is projected to hold about 60 per cent of world total stocks of rice in 2023. India is also expected to considerably increase grain stocks, including rice.

China is projected to hold about 60 per cent of world total stocks of rice in 2023. India is also expected to considerably increase grain stocks, including rice.

USDA

Rice stocks are forecast to increase to 112 million tonnes in 2023 after a decline through 2016. A number of factors are driving these increases. World production of most crops, including rice, has increased faster than use, increasing stocks. Following the volatility in commodity prices since 2008, policies have also tended to support higher stock levels in many countries. In China, policies supporting producers have led to the accumulation

of large stocks of grain including rice. Similarly, Thailand now holds large rice stocks, and India also has large stocks of rice, in part due to policies aimed at providing food security.

FAPRI

Rice is not included in the FAPRI projection.

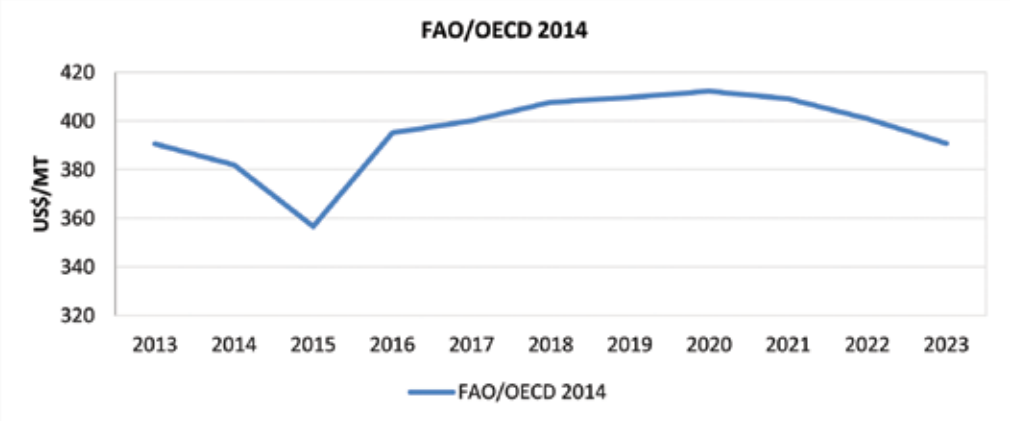
IGC

World rice stocks (aggregate of respective local marketing years) are forecast to total 103.4 million tonnes in 2014-15. Over much of the medium term, global rice carryover is projected to fall markedly, to 95.4 million tonnes in 2019-20 (the year for which projection data are available), significantly below the forecast by other agencies. The contraction is attributed to an expected drawdown in reserves held by major exporters, mainly Thailand and India. In India, increasing domestic use and high export volumes are likely to result in a drawdown of stocks, projected at 11.9 million tonnes in 2019-20. Nevertheless, this would still be comfortably above the official minimum desired level.

The Government of Thailand implemented a paddy mortgage scheme in October 2011. With intervention prices set well in excess of world market values, stock levels ballooned as farmers sold the bulk of their production into the scheme. Following the disbanding of the support programme in February 2014, efforts were stepped up to sell reserves through a series of auctions and diplomatic channels. With such actions likely to continue, especially as exports move higher, Thailand's carryovers are likely to fall during the next five years to 7.7 million tonnes by 2019-20, the lowest in nine seasons. In China, while a marginal downward trend is expected amid limited prospects for production growth and declining imports, stocks are set to remain substantial. Among Asia's traditional rice importers such as Indonesia and Philippines, although efforts to promote self-sufficiency are expected to continue, stocks are projected to edge higher as governments in these countries are still likely to rely on imports to ensure adequate reserves.

II.3.2.e Price

Figure II.10: Global Rice Price



OECD/FAO

Rice prices over the projected period are anticipated to follow the recent trend since 2011 and slide further down, reaching US$ 391/tonne in 2023. This reflects the large supplies accumulated earlier in this decade. In particular, exporting countries in Asia amassed large inventories, which will take long to offload on the market and will weigh on international prices at least until 2015. After this, nominal world prices are projected to recover but will continue to fall in real terms.

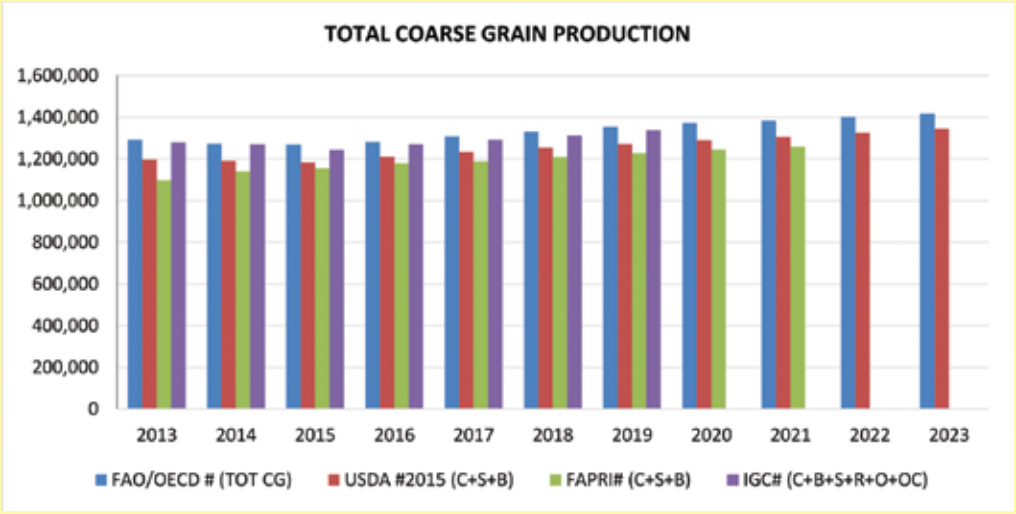
While FAPRI projections do not cover rice, the other two agencies, namely USDA and IGC, have not projected rice prices in the medium term.

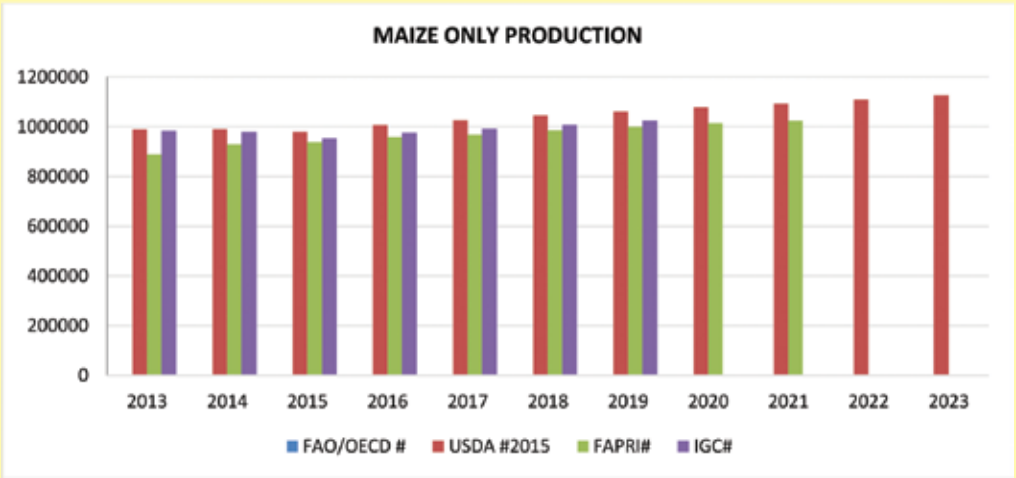
Rice prices over the projected period are anticipated to follow the recent trend since 2011 and slide further down, reaching US$ 391/ tonne in 2023.

II.3.3 Coarse grains

II.3.3.a Production

Figure II.11: Global Total Coarse Grain Production (Thousand Metric Tonnes)





Note: The total coarse grain production projections by the four agencies are not strictly comparable as coarse grains included in the total are different for different agencies. However, we have discussed corn (maize) and sorghum (jowar), India's two major coarse grain crops, where data and information are available. Although bajra (pearl millet) is a major coarse grain crop in India, no agencies have discussed or projected the production of this commodity separately in the global context.

OECD/FAO

World total coarse grain production (which apparently includes maize, corn, barley, oats, rye, millet and other coarse grains) is projected to reach 1,418 million tonnes by 2023, up 17 per cent from the base period with significant increases projected for Argentina, Brazil, China, the Russian Federation, Ukraine and the United States. Yields are projected to increase at 0.8 per cent per annum, slower than in the past and crop area is expected to moderately expand, limiting the scope for a faster increase in production. The additional demand for bio-fuel production should support the area expansion of coarse grains in developed countries. In developing countries, the main driver is the feed demand for livestock production.

USDA

USDA projects total global coarse grain production (which include only corn, sorghum, and barley) at 1,344 million tonnes by 2023, a 12.5 per cent increase over the projection period. Continued global expansion of bio-fuel production during the next decade, although at a slower pace than over the last half decade, should also support higher coarse grain production, particularly maize, as yield growth through technological enhancements and area expansion continue. However, early years in the projections exhibit slower growth in area as low prices induce some countries to reduce planting on marginal cropland. While some countries have the potential to expand arable land, many countries have a limited ability to expand planted area. The growth rate for world average crop yields has been slowing for nearly two decades and is projected to slow further in the next 10 years.

FAPRI

FAPRI projection of total coarse grains (includes only corn, sorghum and barley) is 1,258 million tonnes by 2021 (the latest year for which projections are available), a 14.7 per cent increase over 2013.

IGC

IGC projects global total coarse grain production (which include corn, sorghum, barley, oats, rye, and other minor coarse grains), at 1,339 million tonnes by 2019 (latest available projection year), an increase of 4.5 per cent over 2013.

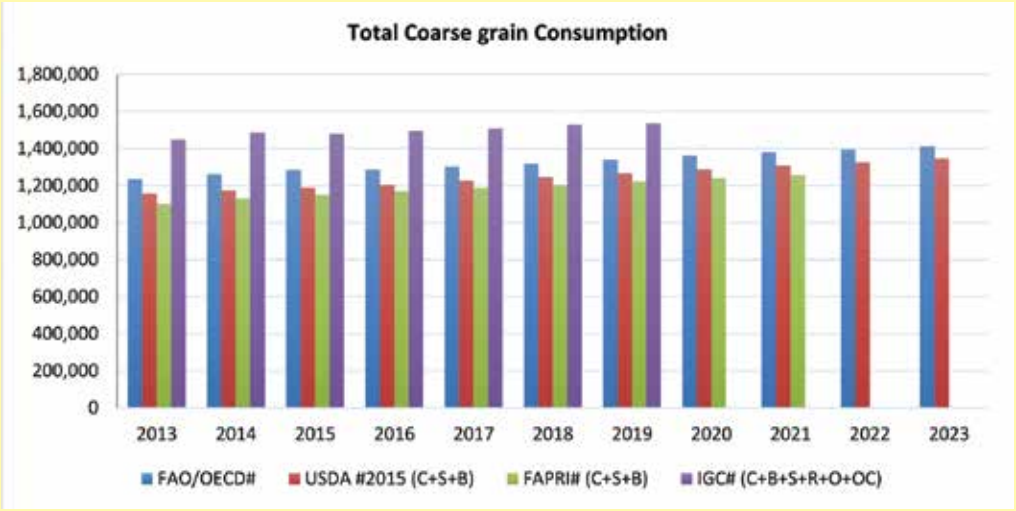
Global corn harvest in the past two years were record or near record highs and production is predicted to be larger than average during the next five years. Although output in the next two seasons may dip below the 2014-15 total, harvests are projected at record levels after 2017-18. Owing to constraints on the availability of arable land in some countries, area expansion is likely to be much slower, with production growth instead mainly linked to productivity gains. By 2019/20, world corn production is projected to reach 1,025 million tonnes.

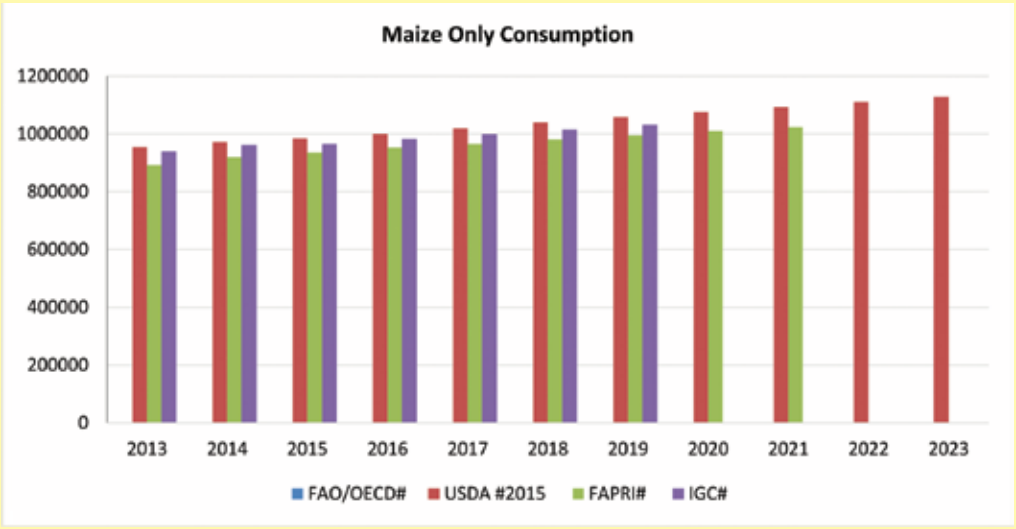
The global area planted to sorghum is projected by IGC to decline in 2015-16, but is then expected to increase modestly, reaching 40 million hectares in 2019-20. Area expansion is expected to be constrained by farmers' preference for other crops, particularly maize in the US, due to its higher average productivity. Nevertheless, because of low input and water requirements relative to alternatives, it will remain an attractive option in marginal

areas, including in parts of Argentina, Australia and Africa. Average sorghum yields are expected to increase, although gains will likely be constrained by low commercial investment in new varieties. After a modest decrease in 2015-16, world production is projected to expand by about 1 per cent annually to 65 million tonnes in 2019-20.

II.3.3.b Consumption

Figure II.12: Global Coarse Grain Consumption (Thousand Metric Tonnes)





OECD/FAO

Despite a slower growth rate than in the previous decade, global consumption of total coarse grains is projected to increase by 20 per cent by 2023 as compared to the base period. This is driven largely by expansion in the demand for feed, which holds the largest share of total utilisation. Moderate increases in demand for industrial uses in developed countries and food in developing countries are also expected, the latter following larger population growth in these countries. The strong developments in feed use are mostly driven by strong growth in China, United States and Brazil. Among

Despite a slower growth rate than in the previous decade, global consumption of total coarse grains is projected to increase by 20 per cent by 2023

its industrial uses, maize-based ethanol production in the United States is projected to continue expanding after reaching the target under the Energy Independence and Security Act of 2007, with considerable increase in ethanol exports. Within the United States, the share of maize used for ethanol production goes up to 44 per cent of total domestic production. World use of total coarse grains for production of bio-fuels is projected to reach 173 million tonnes, representing 12.2 per cent of world total coarse grain utilisation.

USDA

World consumption of total coarse grains is projected to rise 15 per cent over the next 10 years to touch 1,345 million tonnes, including 1,128 million tonnes of corn. Ethanol production in the United States is projected to be relatively flat over the next decade, with most production using maize as the feedstock. About 35 per cent of total maize use in the US is projected to go to ethanol production.

FAPRI

FAPRI projects total coarse grain consumption to touch 1,255 million tonnes by 2021, an increase of 30 per cent over 2013.

IGC

World maize consumption is projected to increase to new highs in the medium term with gains in use for feed, food and industrial processing. Consumption is projected 0.4 per cent higher in 2015-16, with average growth in the next four years pegged at 1.7 per cent, lifting total use to 1,031 million tonnes by 2019-20. Maize is by far the most widely used feed grain crop, with feed use averaging more than 500 million tonnes annually during the past five years. Feed demand accounted for an average 57 per cent of overall maize use over this period and is expected to be the main driver of growth in the medium term.

With an underlying, long-term upswing in global meat demand projected to remain in place during the next five years and beyond, total feed grain consumption will increase to new highs. After a projected slight drop in 2015-16, feed maize demand is forecast to build thereafter, with an annual average growth rate of 2 per cent between 2016-17 and 2019-20. Feed use is expected to increase particularly quickly in developing countries like India, where livestock and poultry production is switching to larger, commercialised operations, which typically utilise more compound feed ingredients.

Industrial use of coarse grains in general and maize in particular will continue to expand, at a slower pace than recently, with consumption growth forecast to average 1.1 per cent annually, compared to 3.1 per cent in the five preceding years and the 15.9 per cent average between 2005 and 2010. Consumption constraints in the US ethanol market should limit further industry expansion and, unless adoption of high ethanol fuel blends exceeds current expectations or exports increase particularly strongly, production of maize-based bio-fuels is expected to rise only slightly from current levels.

Among other countries, use for ethanol is projected to increase in Canada, the EU and South America. Given projections of mild economic growth, use for starch is forecast to increase, led by gains in China.

Direct human consumption of maize, an important food staple in parts of Africa, Asia and Latin America, where it is widely consumed as porridge, breads or tortillas, typically accounts for just 11 per cent of overall use. Due to changing tastes and incorporation of more wheat-based foods and meat in diets, food use of maize between 2015-16 and 2019-20 is projected to increase at a slightly slower pace than in recent years.

Global *jowar* consumption is expected to increase gradually at around 1 per cent per annum, reaching 65 million tonnes in 2019-20. Human food use is projected to rise steadily, mainly in developing countries, although diversification of diets away from traditional staples will restrict gains. Demand for feed and industrial uses of jowar will be influenced by costs relative to **maize**. Industrial demand for **jowar** is also seen rising at a relatively fast pace, growing by 2 per cent annually to nearly 7 million tonnes, although this is a lower rate of increase than in recent seasons. This was mostly led by strong gains for ethanol in the US, but use is expected to grow less quickly in the medium term as ethanol blending is already close to the maximum level for the most common E10 fuel. Feed use of jowar is projected to rise slightly over the five years, to 28 million tonnes globally, although much will depend on prices relative to alternatives.

II.3.3.c Trade

OECD/FAO

Total coarse grain trade is projected at around 167 million tonnes by 2023, an increase of 21 per cent over 2013. With 52 million tonnes, the United States is projected to remain the main coarse grain exporter, followed by Argentina and Brazil, adding another 56 million tonnes.

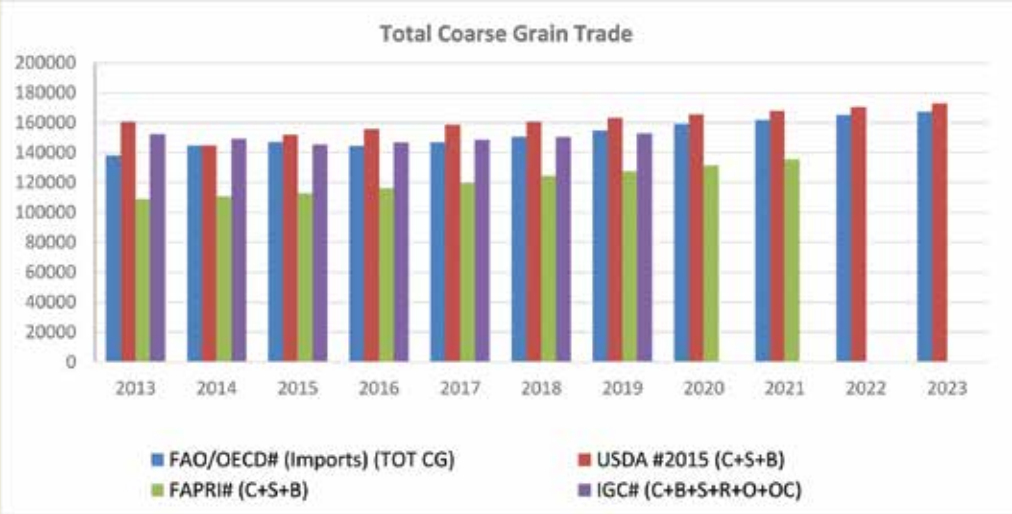
Total coarse grain trade is projected at around 167 million tonnes by 2023, an increase of 21 per cent over 2013.

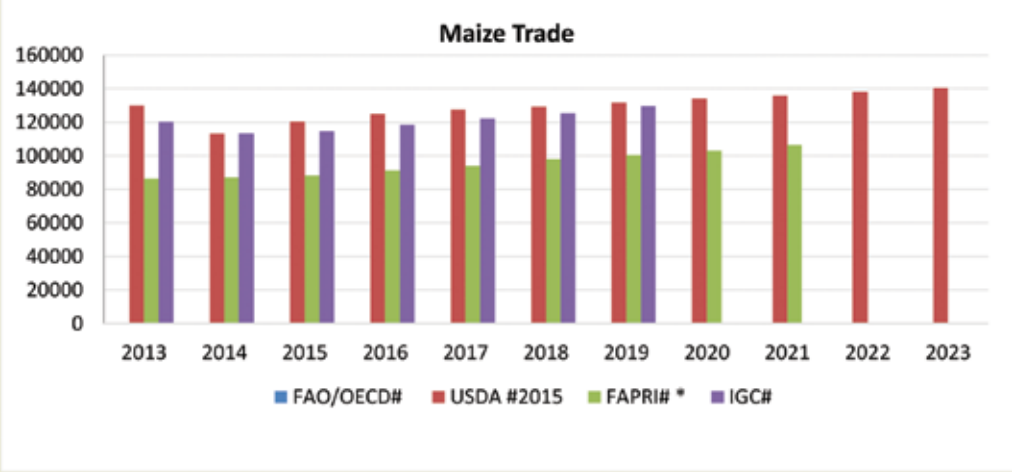
USDA

Coarse grain trade is projected to increase by 23.8 million tons (15 per cent) between 2015-16 and 2024-25 at 172 million tonnes, closer to the OECD/FAO forecast. Corn is expected to gain an increasing share of world coarse grain trade. Expansion of livestock production in feed-deficit countries continues to be the principal driver of growth in coarse grain imports.

Imports by Africa and the Middle East account for about 25 per cent of the growth in world total coarse grain trade through 2024-25, as rising population and income sustain strong demand growth for livestock products and limited arable land. Mexico's corn imports are projected to rise from 11.4 million tonnes in 2015-16 to 15 million tonnes in 2024-25, reaching the level of projected imports by Japan – the current global leader. Southeast Asian and Oceania corn imports rise 42 per cent to 14.2 million tonnes by 2024-25 in response to increased demand from livestock producers and the shift to modern feed rations. These two regions account for 19 per cent of the growth in world corn imports.

Figure II.13: Global Trade in Total Coarse Grains (Thousand Metric Tonnes)





* FAPRI data do not include inter-regional trade.

FAPRI

Corn trade is projected to increase over the projection period, reaching 129 million tonnes in 2025-26. The US market share dropped in 2010-11 and 2011-12 because of lower US exports, but it increases over the rest of the projection period with declines in Brazil and Argentina's market shares. China is projected to become a net importer of corn in 2016-17, with net imports reaching 6.4 million tonnes in 2025-26. Among other coarse grains, world sorghum net trade is projected to grow over the projection period, reaching 10.8 million tonnes by 2025-26 with growth in demand. Regarding barley, EU's net exports are projected to reach 2.8 million tonnes in 2025-26, whereas Australia's net exports of barley are projected at 3.6 million tonnes in 2025-26, and Canada's exports at 3.0 million tonnes. Net exports of barley from Ukraine and Russia are projected to reach 8.4 million tonnes and 7 million tonnes respectively in 2025-26.

IGC

Maize

Amid strengthening demand for meat and industrial products and with maize availability expected to remain in fairly good supply, world trade is projected to rise in each of the next five years. While forecast imports for 2015-16 (July/June) are placed at only 1.3 per cent above the current season, growth is expected to strengthen in the subsequent four years, averaging some 3.1 per cent annually. By 2019-20, global maize trade is forecast at 130 million tonnes. China's imports are forecast to increase. On a July-June basis, imports by China are projected at around 11.3 million tonnes by 2019-20, compared to an estimated 3.0 million tonnes in the base year.

Japan is projected to remain the world's biggest importer, with shipments slowly rising to around 15.8 million tonnes in five years. Strengthening demand for animal feed ingredients is forecast to boost imports by Mexico to around 12.0 million tonnes by 2019-20. Assuming larger than average crops in the next five years, EU imports are unlikely to reach recent highs and are seen at 8.1 million tonnes by the end of the outlook period.

The four major exporters (Argentina, Brazil, Ukraine, US) are projected to account for an average 85 per cent of exports over the next five years. The US will remain the dominant exporter and should be well placed to meet rising demand from China and Mexico, with July-June shipments forecast at 53.5 million tonnes in 2019-20, up by around 10.2 million tonnes from 2014-15 levels. Due to expanding domestic demand, exports by Brazil are forecast to be fairly steady, averaging some 20.7 million tonnes. Rising feed and industrial consumption in Argentina may limit average exports to around 15.5 million tonnes. Projected large surpluses should enable Ukraine to increase shipments, bolstering its position as the world's third largest exporter.

Barley

Total trade in barley is projected to rise by an average of 1.5 per cent per annum, with an initial decline offset by growth in subsequent years, reaching 23 million tonnes 2019-20. Imports are seen being boosted by higher demand for feed, particularly in Near East Asia, and by expanding malting barley requirements, especially in Pacific Asia. Purchases for feed will continue to account for most of the trade, representing about 80 per cent of the world total. Saudi Arabia is expected to remain the single largest buyer, maintaining a 41 per cent share.

Stronger demand for malt processing will help underpin shipments to Pacific Asia and South America. Higher barley imports by China are expected to be partly linked to the re-export as malt to other countries in the region, which have insufficient processing capacity of their own.

The major export origins are projected to stay broadly similar to that in the last five years, namely the EU, Australia, Argentina, Russia, and Ukraine.

Sorghum

From previously importing negligible quantities, China has become by far the largest buyer, accounting for 60 per cent of all trade during 2014-15. Due to tariff rate quotas

and worries about unapproved GM maize, China's feed millers have turned to greater purchases of sorghum, mostly from the US.

II.3.3.d Stocks

FAO/OECD

Higher production of corn in the US has led to a rapid recovery of coarse grain stocks. Total coarse grain stocks are projected to decline until 2016 and then gradually increase to 268.3 million tonnes by 2023, an increase of 8.2 per cent over 2013.

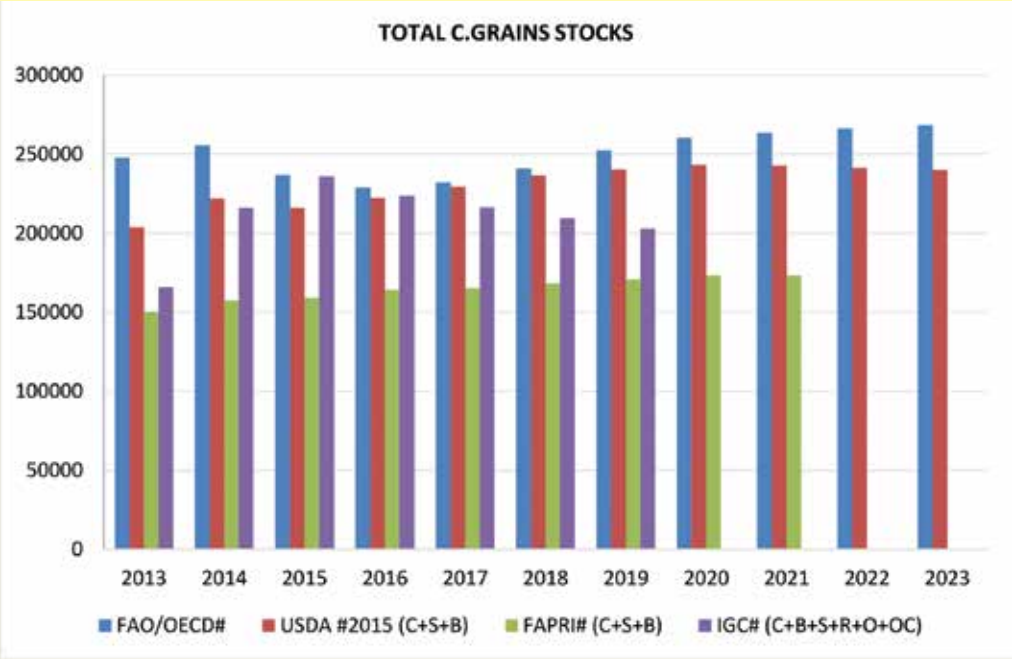
USDA

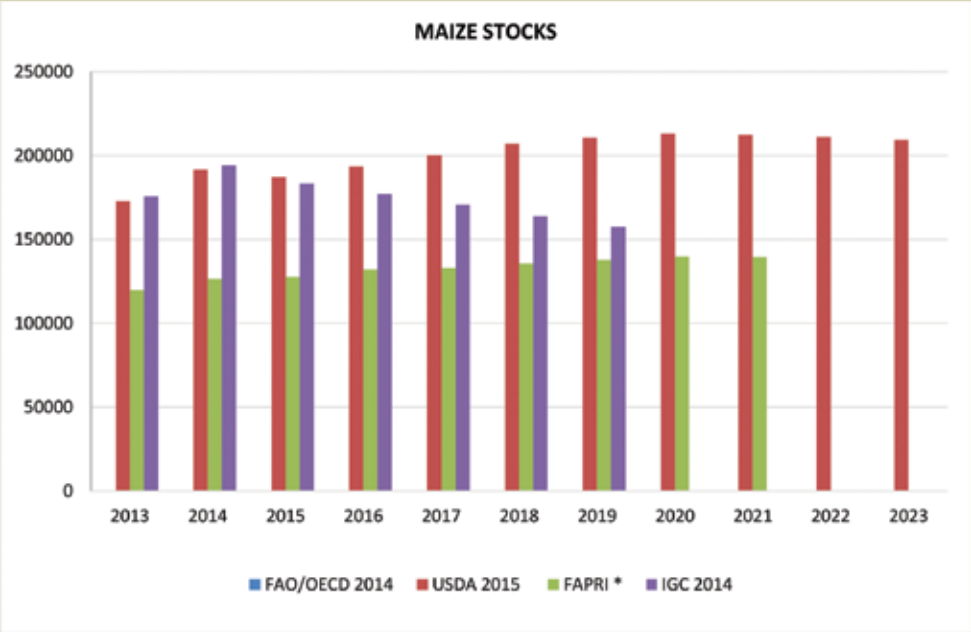
Global stocks have increased during the past few years. A number of factors are driving these increases. World production has increased faster than use, increasing stocks and easing price levels. Following the volatility in commodity prices since 2008, policies have also tended to support higher stock levels. USDA forecasts that global total coarse grain stocks will increase to 240 million tonnes by 2023, including 209 million tonnes of corn.

FAPRI

FAPRI projects total coarse grain stocks, which include corn, sorghum, and barley, at 173 million tonnes in 2021, including 140 million tonnes of maize, an increase of 23 million tonnes over 2013. FAPRI maize stocks projections are significantly below that of the USDA's.

Figure II.14: Global Coarse Grain Stocks (Thousand Metric Tonnes)





IGC

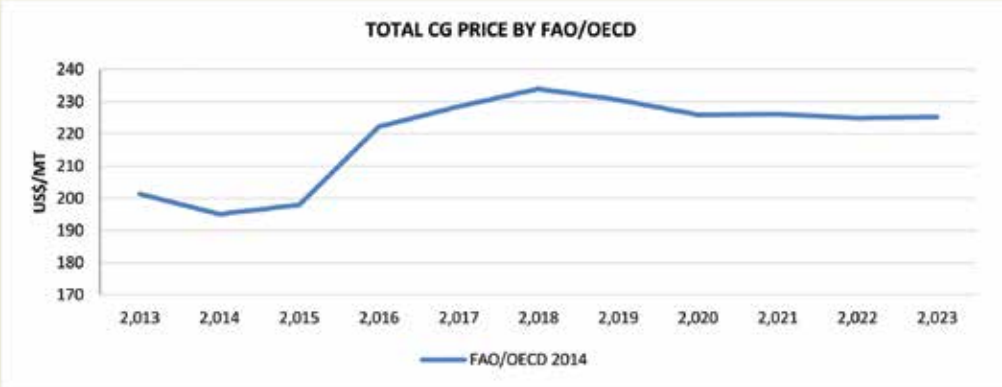
IGC projects global stocks of total coarse grains, which include corn, barley, sorghum, oats, rye and other minor coarse grains at 202.6 million tonnes by 2019, including 157.7 million tonnes of corn. After recent increases, the global stocks-to-use ratio is expected to tighten and is seen falling to 15 per cent by the end of the five-year period in 2019, down from 20 per cent at the end of the current season and similar to the lows seen in 2011-12. Cumulative carryovers of corn in the four major exporters (Argentina, Brazil, Ukraine, US) are forecast to fall to 55 million tonnes by the end of 2019-20.

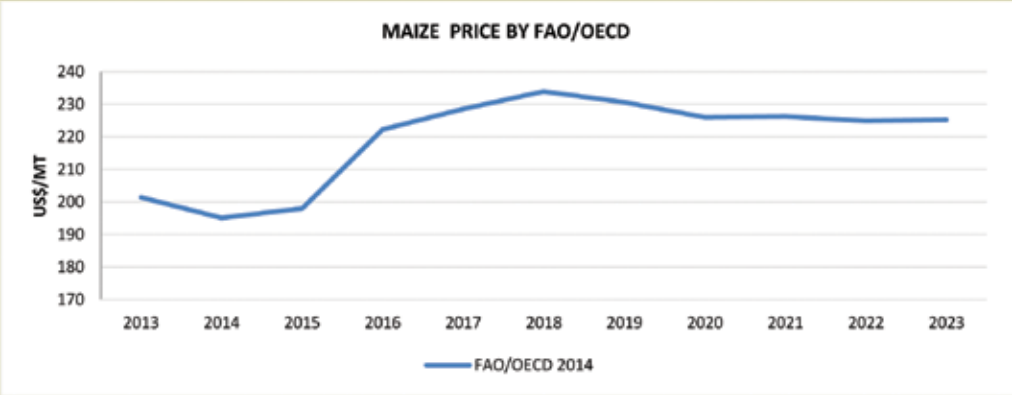
II.3.3.e Prices

OECD/FAO

World prices of total coarse grains are expected to considerably decrease in the first five years of the outlook period as a response to anticipated production prospects in major producing countries of the United States, Russian Federation, and Argentina. Subject to average weather conditions, the representative maize Gulf price is forecast to recover and stabilise over the second half of the projection period at around US$225/tonne in nominal terms ($160/t in real terms).

Figure II.15: Global Coarse Grain Price





USDA

Prices of most agricultural commodities in general and of coarse grains in particular have fallen from recent high levels and are projected to fall further during the initial years of the projections, before gradually increasing over the remainder of the coming decade. USDA has not given any projections of global coarse grain price.

FAPRI

World corn price (FOB GULF) is projected to increase somewhat during the first few projection years and then decline marginally to around US$ 200 per tonne by 2023. However, sorghum and barley prices are projected to increase continuously, albeit modestly.

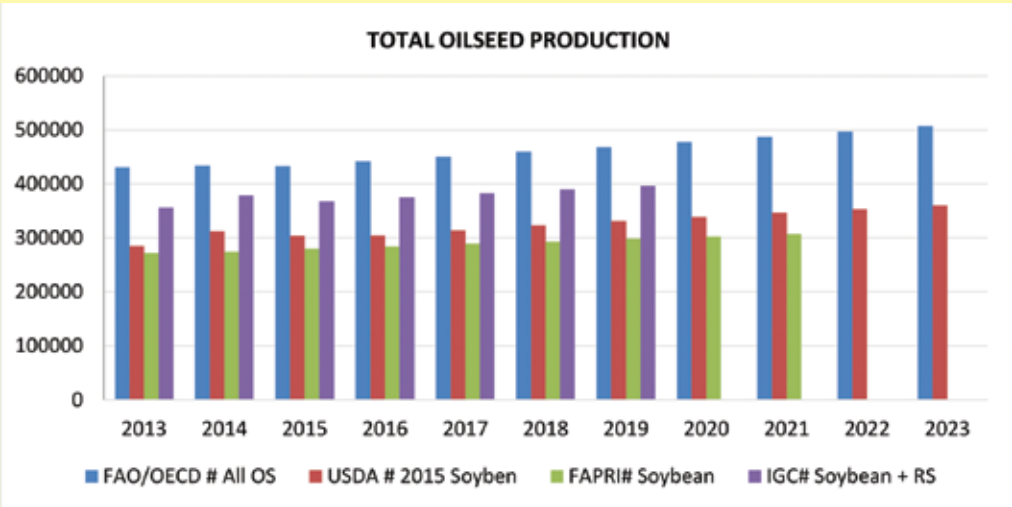
IGC

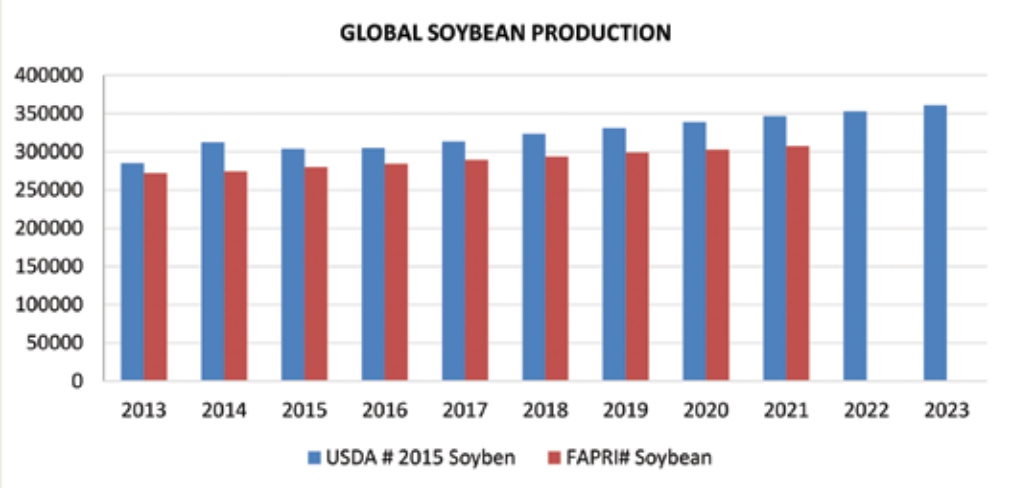
IGC has not projected global coarse grain prices.

II.3.4 Oil seeds/Soybean

II.3.4.a Production

Figure II.16: Global Soybean Production (Thousand Metric Tonnes)





Note: Like total coarse grains, total oilseed production projections by the four agencies are not strictly comparable as oilseeds included in the total are different for different agencies. However, we have discussed soybeans and rapeseed/mustard in particular and other oilseeds such as groundnut for which data and information are available.

OECD/FAO

Relative profitability of coarse grains vs. oilseeds is expected to favour the allocation of land toward oilseeds, which combined with yield gains is expected to lead to a 26 per cent increase in world oilseeds production (includes most types of oilseeds) over the coming decade to 507 million tonnes, with most of the increase being in soybean production. Projected global area expansion is 11 per cent, and yield growth 14 per cent. The United States is projected to remain the leading oilseeds producer with a global share of 21 per cent by 2023. Argentina, Brazil, Paraguay, and Uruguay together are expected to account for 30 per cent of world oilseeds production. The combined Russian Federation, Ukraine and Kazakhstan are expected to maintain their share of 6.6 per cent of world oilseeds production. Canada will maintain its share at 5 per cent throughout the outlook period. In the European Union, oilseed production is projected to increase by 19 per cent to maintain its share of 7 per cent of the world total, supported by increasing use of bio-diesel to meet the Renewable Energy Directive. This will be driven mostly by yield increases.

USDA

USDA oilseed production covers only soybeans, world production of which is projected to reach 360 million tonnes by 2023, an increase of 26 per cent over 2013.

FAPRI

FAPRI total oilseed production projection data includes soybeans and rapeseed. Soybean production is projected at 307 million tonnes during the projection period ending 2021, an increase of 13 per cent as a result of higher area and yields.

Rapeseed/mustard production is expected to resume its upward trend since 2011-12 and projected to reach 75 million tonnes (a 29 per cent increase from the 2010-11 season) by the end of the projection period in 2021-22.

IGC

IGC projection includes soybeans and rapeseed/mustard.

Soybeans: World soybean production is projected to increase steadily during the medium term to touch 321 million tonnes in 2019-20. World plantings are projected at 125 million hectares in 2019-20 with the combined area in Argentina, Brazil and the US at around 90 million hectares. In addition to the projected increase in global plantings, improvements in seed technology and enhanced farming practices, such as soil management and better control of weed growth and pest infestation, are expected to underpin marginal gains in average world yields during the next five years.

Rapeseed/mustard: IGC projects global rapeseed/mustard production to reach 74.9 million tonnes by 2019-20. Owing to comfortable supplies and low prices, the global harvested area is projected to decrease by 1.3 per cent in 2015-16, before recovering in subsequent years. After two years of exceptionally high yields, productivity levels are tentatively seen returning to normal in 2015-16, and then trending higher. Most of the increase is expected to be in Canada, where production is projected at 17.5 million tonnes by 2019-20, although this is still short of the 2013-14 record. Growth will be underpinned by larger plantings as farmers respond to rising domestic and international demand, while yields are assumed to gently trend higher. Production is projected to increase in EU, Ukraine, and Russia.

Owing to comfortable supplies and low prices, the global harvested area is projected to decrease by 1.3 per cent in 2015-16, before recovering in subsequent years. After two years of exceptionally high yields, productivity levels are tentatively seen returning to normal in 2015-16, and then trending higher. After reaching a record in 2014-15, EU production is projected to decline sharply in 2015-16 due to reduced plantings and a return to average yields. While output is seen recovering in the following years as plantings expand, yield potential could be compromised by the ban on a controversial but effective insecticide.

Plantings in Ukraine for the 2015-16 harvest are estimated to have fallen. Together with the likelihood of lower yields, as farmers cut back on essential inputs owing to difficult economic conditions, production is seen falling markedly. Total area and average productivity are projected to rise in subsequent years, but would still be below earlier peaks. In Russia, where most of the crop is sown during spring, and thus subject to more benign climatic conditions, output is expected to grow further, underpinned by larger plantings – averaging 40 per cent more than in the previous five-year period.

II.3.4.b Consumption/crush

OECD/FAO

Based on the projected smaller rate of growth in global oilseeds production, annual average growth in world total oilseed crush is expected to be 2 per cent during the projection period, compared to 3.5 per cent in the previous decade to reach 507 million tonnes. The growth, in absolute terms, translates into an expansion of 96.5 million tonnes over the outlook period. The largest expansion in crush volume is projected to come from the MERCOSUR countries with 36.4 million tonnes, followed by China with 25 million tonnes.

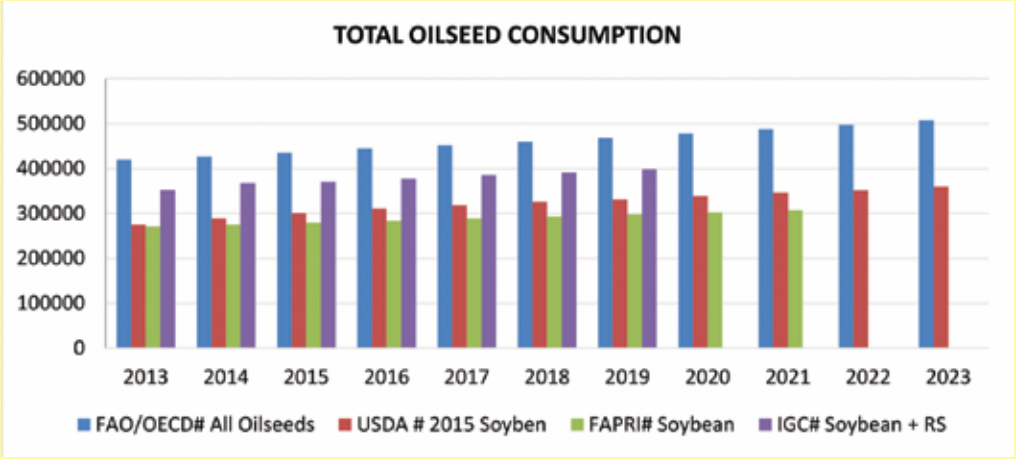
USDA

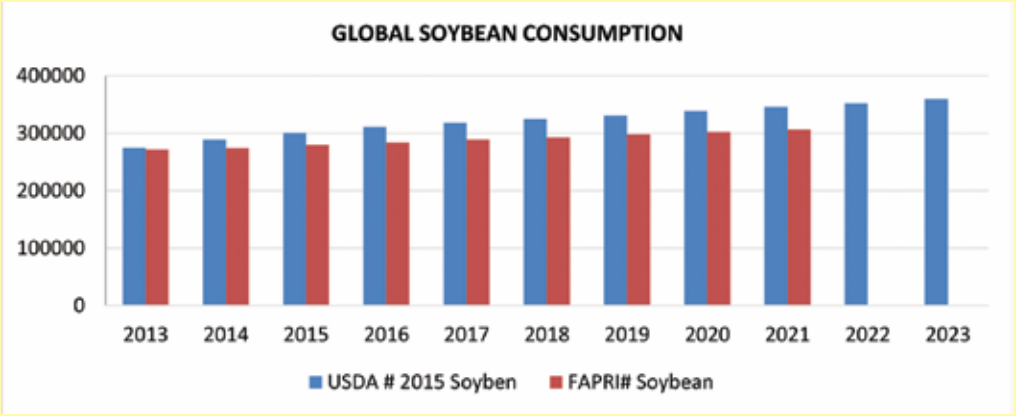
USDA projects global soybean crush to increase to 360 million tonnes during the projection period, an increase of 31 per cent.

FAPRI

FAPRI projects global soybean crush to increase to 307 million tonnes during the projection period, an increase of 13 per cent.

Figure II.17: Global Consumption/Crush (Thousand Metric Tonnes)





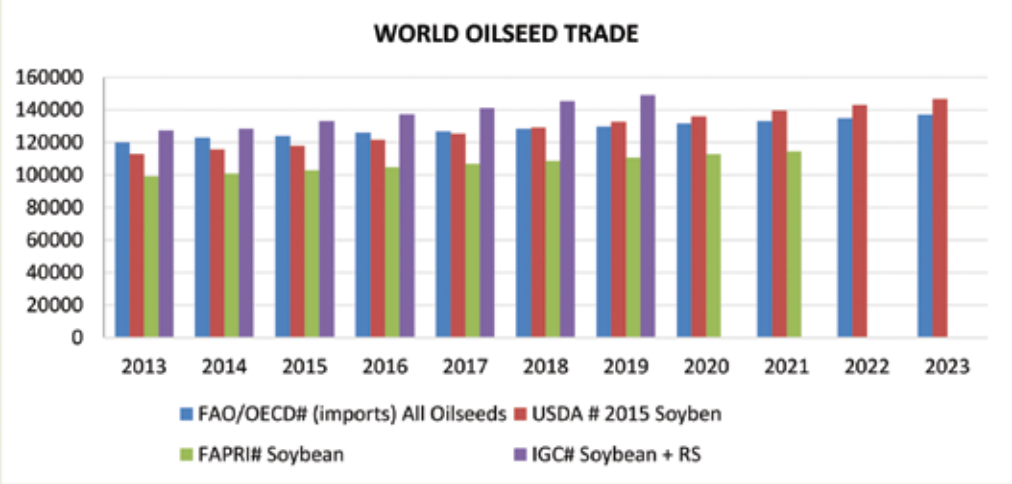
IGC

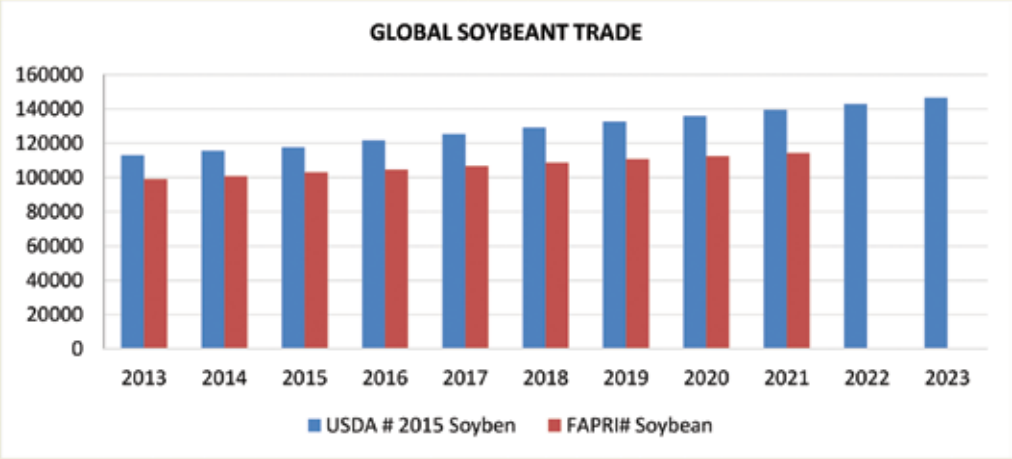
Global consumption of soybeans is projected to expand further during the next five years, increasing by 27 million tonnes, or an average of 1.7 per cent per annum to 324 million tonnes in 2019-20. With only nominal volumes of the unprocessed oilseed being channelled directly to end-use sectors, the expected expansion is almost entirely due to an increase in soybean crush, accounting for 90 per cent of total use during the entire period. Within this component of demand, much of the anticipated rise reflects demand for soy meal from the livestock and poultry sectors. In addition, to being the most abundantly produced of all oilseed meals, the attractiveness of soy meal as a feed ingredient stems from its high protein quality and nutritional value compared to alternatives. In recent years too, the growing use of soy meal in aquaculture feeds has been particularly notable.

Against the backdrop of growing demand for rapeseed products, especially in Far East Asia, global rapeseed consumption is expected to continue expanding. Although tighter availability in 2015-16 is likely to result in the first annual contraction in nine years, total use is projected to increase over the remainder of the medium term. In the EU, the crush is projected to dip in 2015-16 owing to tighter supplies, but should register moderate growth thereafter, fuelled by an expansion in the consumption of bio-fuel sector. Processing in China is likely to expand further due to rising demand from the feed and food sectors. However, growth is expected to be slower than in earlier years, contained by ample supplies of alternatives, including soy meal.

II.3.4.c Trade

Figure II.18: Global Oilseed Trade (Million Metric Tonnes)





* FAPRI trade data do not include inter-regional trade.

OECD/FAO

The average annual growth rate of world trade in oilseeds is expected to slow down considerably in the next decade, compared to the previous decade, mainly linked to the projected deceleration in oilseed crushing in China. Imports by the second largest importer of oilseeds, the EU, will remain stable as increased crush demand is met

primarily by rising domestic production. Imports by China and the EU account for 71 per cent of oilseed imports by 2023. Overall, world exports in oilseeds remain highly concentrated to the US, Canada, Brazil and Argentina with these four countries projected to account for 82 per cent of the market share in 2023. Exports from the United States (mostly soybeans) and Canada (mainly rapeseed) are projected to grow by around 22 per cent over the projection period. Brazil's exports, mostly soybeans, will increase by 8 per cent over the next decade, while Argentina's exports, also mainly soybeans, are projected to increase by 21 per cent.

IGC

Soybeans: World trade in soybeans (October-September) is projected to expand continuously during the medium term as increasing demand for animal protein and rising food use boosts global import needs. Nevertheless, growth will be less pronounced than in the previous five years, owing to an expected slowdown in the rate of increase of China's purchases. By 2019-20, global shipments are projected to reach about 133 million tonnes, some 16 per cent higher than in 2014-15.

China is by far the largest importer of soybean; its annual purchases, which are largely channelled to the country's huge feed sector, almost exclusively shape the pattern of world trade. Imports are set to rise only modestly in 2014-15 after the heavy volume imported in the previous year boosted inventories and resulted in a marked erosion of processing margins. After averaging an annual growth rate of around 6 per cent during 2010-11 to 2014-15, imports are projected to expand by around 4.3 per cent per annum over the next five years. With production projected to dwindle further, China's imports are set to account for an increasing proportion of domestic requirements.

Shipments to other relatively small markets in Asia are expected to rise further, tied to higher incomes and strengthening demand, especially for feeding. Although crush facilities have been set up in recent years, many of the region's buyers continue to rely on soy meal imports, and this is expected to remain a feature of regional trade flows. Outside Asia, growth prospects appear slim. Deliveries to the EU are set to post only fractional increases, constrained by the likely ample availability of alternatives – including domestic rapeseed supplies and continued large soy meal imports.

The share of the three major exporters in world trade (the United States, Brazil, and Argentina) is projected to be maintained at around 90 per cent during the next five years. With a huge outturn leading to a marked increase in availability, US exports are seen rising to a new record in the current season. Amid expectations for generally comfortable supplies, the country's exporters should be well positioned to capture a sizeable share of the forecast increase in world trade in subsequent years. Brazil is expected to provide sustained strong competition to their US counterparts, with volumes set to move well above 50 million tonnes by the end of the projection period. However, due to logistical constraints, the outlook for rising exports rests on anticipated continued improvements in transportation infrastructure and the expansion of storage facilities to aid stock management and logistics.

Rapeseed/Mustard/Canola: After an expected dip in 2014-15, world rapeseed/canola trade is seen steadily expanding to 16.3 million tonnes in 2019-20 (October-September), marginally higher than the 2013-14 record. Shipments to Far East Asia are likely to continue growing – cantered on China's increasing needs – albeit at a more modest

pace, with imports reaching 8.9 million tonnes. EU imports are forecast to climb during the next five years, by around 40 per cent, to 3.3 million tonnes in 2019-20. Elsewhere, shipments to markets in North and Central America are likely to grow further.

Canada will remain the major supplier to world markets over the medium term with its share of world trade seen at about 60 per cent throughout. By 2019-20, the country's exports are projected at 9.6 million tonnes, 20 per cent more than in 2014-15. Linked to expectations of smaller crops and tighter availability, sales by Australia and Ukraine are likely to decline in 2015-16, before trending up in future years.

Total oilseed stocks, after peaking 51.5 million tonnes in 2014 are projected to decline gradually to 42.4 million tonnes in 2023.

II.3.4.d Stocks

OECD/FAO

The record crops of 2013 and 2014 will replenish total oilseed stocks to levels that should buffer most unanticipated shortfall in production in the short-term. Total oilseed stocks, after peaking 51.5 million tonnes in 2014 are projected to decline gradually to 42.4 million tonnes in 2023.

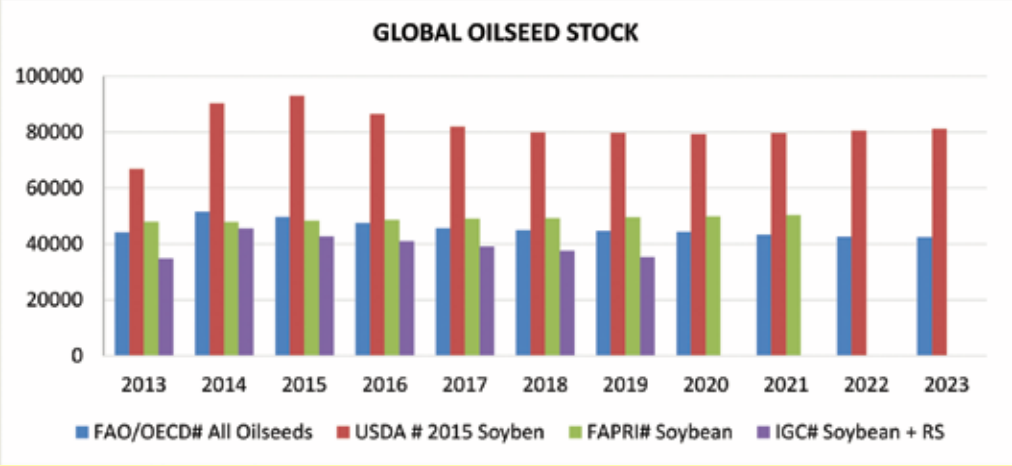
USDA

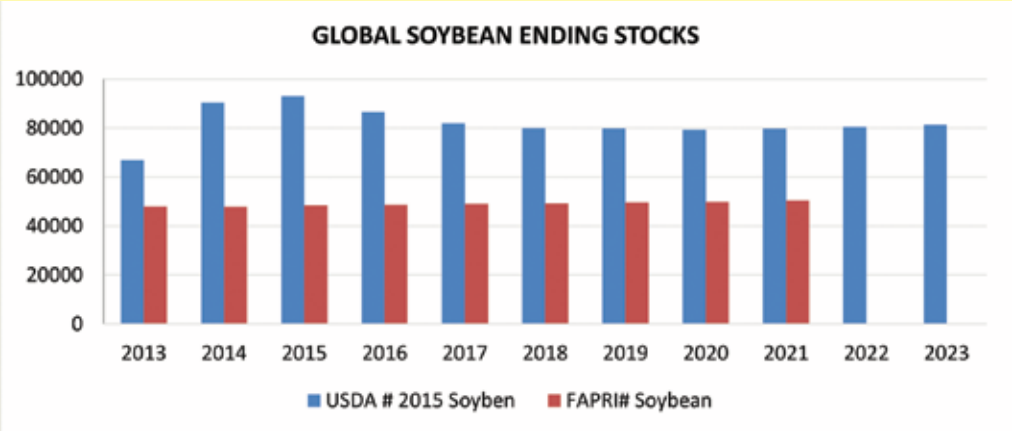
World production of most crops, including oilseeds, has increased faster than use, increasing stocks and easing price levels. Following the volatility in commodity prices since 2008, policies have also tended to support higher stock levels. USDA projects global soybean stocks to increase by 22 per cent to 81 million tonnes by 2023, after peaking at 93 million tonnes in 2015. USDA soybean stocks projections are significantly above projections by other agencies for reasons unknown

FAPRI

The FAPRI projection of soybean stocks by 2021 are 50.3 million tonnes, registering a steady increase from around 48 million tonnes in the initial projection period

Figure II.19: Global Oilseed Stocks (Thousand Metric Tonnes)





IGC

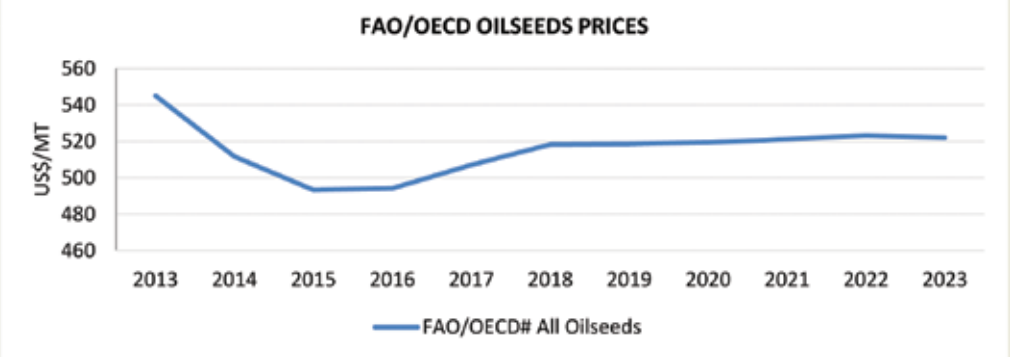
World ending stocks of soybeans (aggregate of respective local marketing years) are seen rising sharply in 2014-15, by nearly 40 per cent year-on-year to around 40 million tonnes. The expansion is centred on expected increases in stocks in major exporting countries, led by the US, where a huge output will substantially swell availabilities. Based on projections for production and consumption, global end-season soybean carryovers are set to fall during the next five years to around 35 million tonnes in 2019-20. However, average stock levels would still be around 10 per cent larger than in the previous five years.

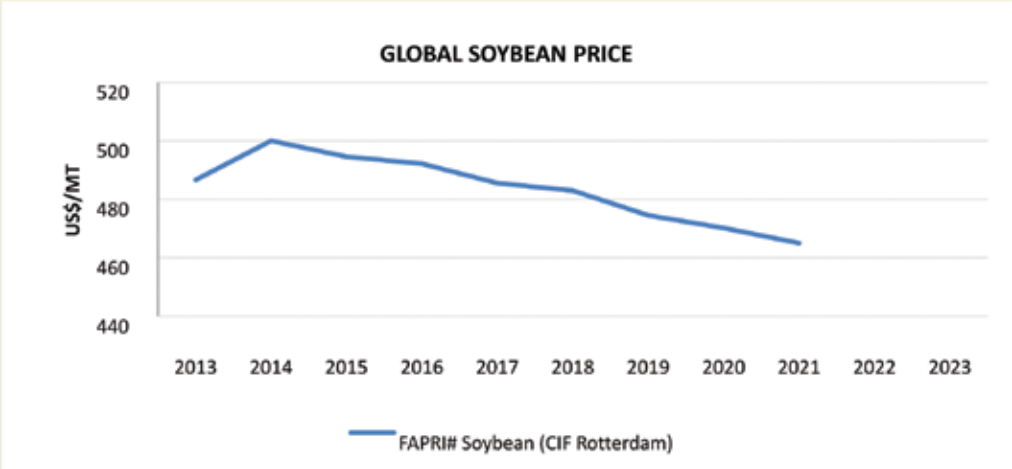
Much of the projected fall is linked to a reduction in stocks with major exporters, mainly Argentina and the US. The former's inventory levels have been built up by good harvests and sluggish farmer selling, but are expected to decline slightly in future years, while US carryovers are seen steadily contracting, to 8.9 million tonnes in 2019-20 (from 12.2 million tonnes in 2014/15). In Brazil, by contrast, where end-season reserves are typically small, little change is seen during the next five years.

Due to expectations of a significant drop in output in 2015-16, global end-season stocks of rapeseed/mustard are projected to decline to 4.6 million tonnes before steadily recovering to 5.7 million tonnes in 2019-20. Within the total, inventories in the major exporters are projected to rise to 1.9 million tonnes (1.5 million tonnes in 2014-15), almost entirely due to Canada.

II.3.4.e Price

Figure II.20: Global Oilseed Prices





After an initial downward correction, prices of oilseeds and products are expected to increase over the medium term due to strong demand for vegetable oils and oilseed meals.

OECD/FAO

After an initial downward correction, prices of oilseeds and products are expected to increase over the medium term due to strong demand for vegetable oils and oilseed meals.

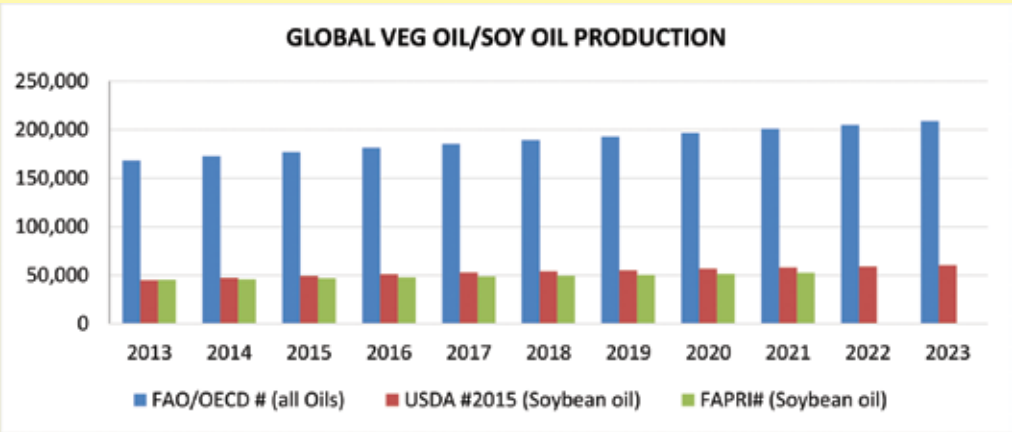
FAPRI

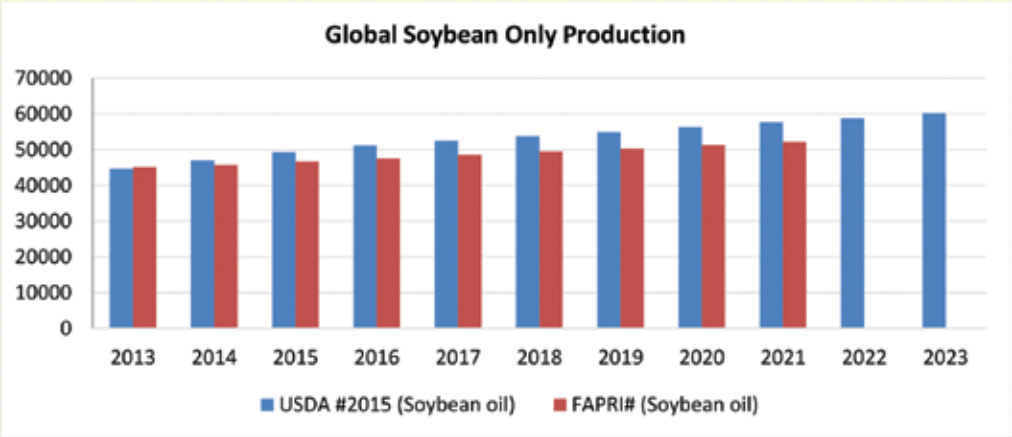
After peaking at US$ 500 per metric tonne in 2014, soybean prices are projected to show a steady decline reaching US$ 465 per metric tonne in 2021. This is somewhat contradictory to the OECD/FAO projections for total oilseeds.

II.3.5 Soybean Oil

II.3.5.a Production

Figure II.21: Global Vegetable Oil Production (Million Metric Tonnes)





OECD/FAO

FAO/OECD projection is confined to total vegetable oils, which apparently include soybean, rapeseed/mustard, palm, groundnut, and sunflower seed oils. World total vegetable oil production is projected to increase by 28 per cent or 46 million tonnes, over the outlook period ending 2023, relative to the 2011-13 average. It is likely to remain highly concentrated with Indonesia, Malaysia, China, the European Union, the United States, Argentina, Brazil, and India accounting for 77 per cent of total production throughout the projection period ending 2023. Malaysia and Indonesia's palm oil production is projected to increase on average at about 2.9 per cent, a slower rate than in the past as land restrictions, environmental restraints and labour costs become more constraining. The share of palm oil production in total vegetable oil output is projected to continue in the first seven years of the outlook period at around 30 per cent but to be almost 36 per cent thereafter. Based on its use of imported oilseeds in the domestic crush, China ranks second in vegetable oil production. World vegetable oil production is expected to remain very concentrated in the coming decade as growth originates in the main producing regions of India and Malaysia.

World total vegetable oil production is projected to increase by 28 per cent or 46 million tonnes, over the outlook period ending 2023, relative to the 2011-13 average.

USDA

Soybean oil production is projected to reach 60.2 million tonnes by 2023, an increase of around 15 million tonnes (29 per cent) during the projection period.

FAPRI

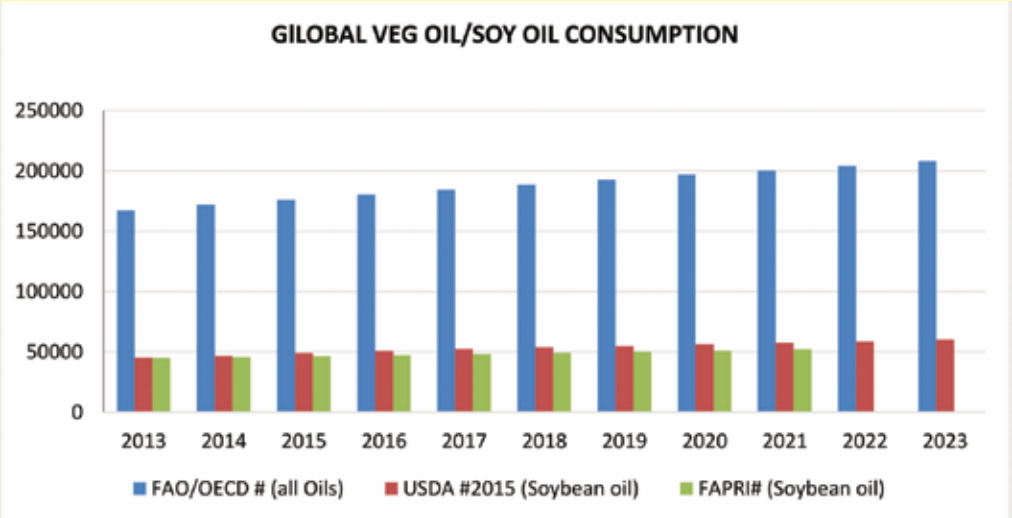
FAPRI projects global soybean oil production at 52 million tonnes by 2021, an increase of 7 million tonnes since 2013. This is about 5.5 million tonnes lower than the USDA projection for 2021.

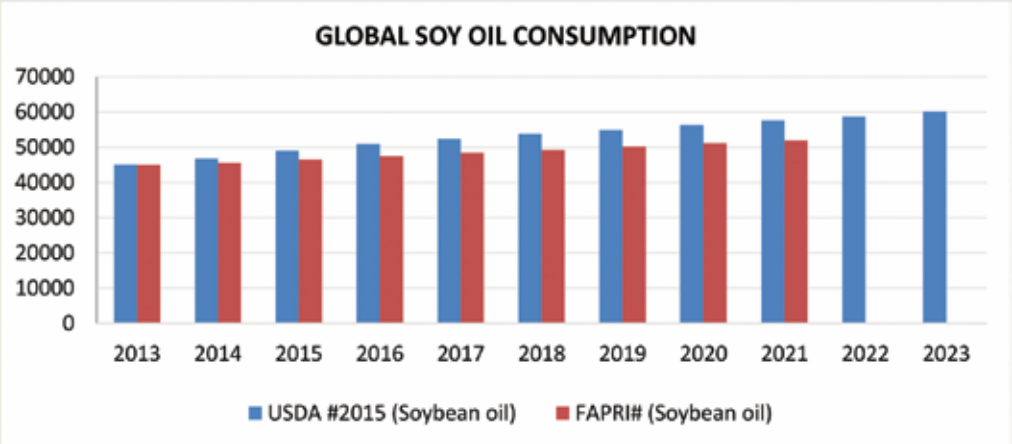
IGC

IGC projections do not cover any edible oils or oil meals, including soybeans.

II.3.5.b Consumption

Figure II.22: Global Vegetable Oil Consumption (Thousand Metric Tonnes)





OECD/FAO projects total vegetable oil consumption to increase to 208 million tonnes in 2023, an increase of 24.4 per cent.

OECD/FAO

OECD/FAO projects total vegetable oil consumption to increase to 208 million tonnes in 2023, an increase of 24.4 per cent. Demand for vegetable oils for food remains strong as global incomes and population grow, and the use of vegetable oils as fuel is supported by consumption mandates. However, the share of biodiesel produced from vegetable oil in global biodiesel production is projected to decrease from 80 per cent in 2013 to 76 per cent in 2023, which corresponds to 14 per cent of global vegetable oil production in 2023. The increase in the share of palm oil production in the first seven years of the outlook period is expected to result in an increase in its share in consumption.

USDA

USDA projection of global soybean oil consumption in 2023 is 60.2 million tonnes, a steady growth over the projection period. Increasing incomes, urbanisation, development of modern food markets and outlets, and continued population growth in developing countries are projected to boost demand for vegetable oils for food consumption and for protein meals used in livestock production. Global expansion of bio fuel production is also projected to continue during the next decade, although at a slower pace than over the previous half decade. As a result, demand for bio fuel feedstock also continues

to grow, but more slowly. Soybean oil is projected to account for about half of total biodiesel production made from methyl esters. The largest bio fuel producers include the United States, Brazil, the EU, and Argentina, based mostly on soybean oil. Indonesia and Malaysia continue to increase production of bio fuel production from palm oil and the Philippines is expanding copra use for bio fuel.

FAPRI

FAPRI projects global soybean oil consumption to increase at a steady pace to 52 million tonnes in 2021 from 45 million tonnes in 2013, somewhat below the USDA projection for 2021. The demand for soybean oil increases by 12.3 million tonnes by 2025-26, a growth of 1.7 per cent per annum. This growth is driven by both expanding food and industrial use. Because of their rising incomes, China and India present the highest growth in demand, which is mostly for food use. Argentina's use grows by 16 per cent on top of the recent strong expansion, driven by strong biodiesel demand.

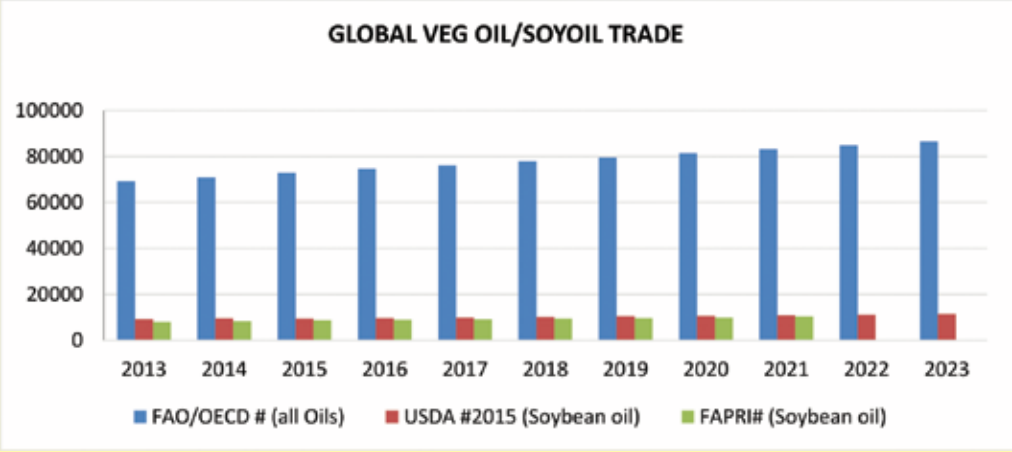
IGC

The expected expansion of global soybean crush through to 2019-20 reflects anticipated growth in the demand for soybean oil from the food and industrial sectors. As in earlier years, rising food use is expected to be underpinned by increased consumption in Asian markets, primarily China and India, where higher incomes and changing diets are boosting demand for vegetable oils. Industrial uses, while representing a relatively small component of overall use, are seen growing further, led by US and South America. Applications are wide-ranging and include the use of soybean oil as a feedstock in biodiesel production, together with an array of other smaller volume applications, such as the manufacture of adhesives, coatings, lubricants and plastics.

Against the backdrop of growing demand for rapeseed products, especially in Far East Asia, global consumption is expected to continue expanding. Although tighter availability in 2015-16 is likely to result in the first annual contraction in nine years, total use is projected to increase over the remainder of the medium term. In the EU, the crush is projected to dip in 2015-16 owing to tighter supplies, but should register moderate growth thereafter, underpinned by uptake in the bio fuel sector. Processing in China is likely to expand further due to rising demand from the feed and food sectors. However, growth is expected to be slower than in earlier years, contained by ample supplies of alternatives including soy meal.

II.3.5.c Trade

Figure II.23: Global Vegetable Oil/Soy Oil Trade (Thousand Metric Tonnes)



OECD/FAO

Vegetable oil imports are less concentrated than oilseeds, with the European Union, China, and India expected to represent 48 per cent of global total oil imports (86.5 million tonnes) in 2023. With a projected increase in imports of 52 per cent, and 63 per cent, China and India's import dependency rates (imports divided by consumption) will reach 36 per cent and 64 per cent respectively. Imports of vegetable oils by the European Union will remain below the average of 2011-13 because of an increase in oilseed crush. Vegetable oil exports are projected to be dominated by a few players, mainly Indonesia and Malaysia (which together will contribute almost two-third of total vegetable oils (mostly palm oil) during the coming decade. Argentina is expected to be the third largest exporter with a share of 9 per cent (mostly soybean oil).

USDA

Global trade in soybeans and soybean products has risen rapidly since the early 1990s and surpassed global trade in either wheat or total coarse grains. Continued strong growth in the global demand for vegetable oil, particularly in China and other Asian countries, is expected to maintain soybean oil trade well above either wheat or coarse grain trade throughout the next decade.

Annual world soybean oil imports are projected to climb by 2.2 million tons (23 percent) to 11.4 million tons over the 2015-16 to 2024-25 projection period, bolstered by rising food and industrial use. Growth in world soybean oil trade is expected to continue to be constrained by competition with palm oil, which is the leading vegetable oil traded internationally.

Although palm oil continues to account for the largest share of India's vegetable oil imports, India surpassed China in 2013-14 to become the world's largest soybean oil importing country. In the projections, India's annual soybean oil imports climb 32 percent to 2.2 million tonnes in 2024-25. Factors contributing to the continued growth of India's soybean oil imports include increased demand for vegetable oils and limited area for expanding oilseed production. Low yields, associated with episodic excessive monsoon rainfall and low input use, also inhibit increased oilseed production.

In 2008, in response to high domestic food price inflation and high world prices, India reduced the import tariff on crude edible oil to zero. Previously, these tariffs equalled was 40 per cent for soybean oil and as high as 85 per cent for other oils. For the projections, it is assumed that India's tariffs on crude soybean oil and other vegetable oils will rise moderately but remain well below pre-2008 levels.

With a rapid increase in China's soybean imports for crushing in recent years, the country's soybean oil imports declined to about 1.1 million tonnes in 2014-15 and are projected to remain at this level in the coming decade.

Argentina and Brazil are the world's first and second largest soybean oil exporters, respectively. Their combined shipments are projected to account for almost two-thirds of world soybean oil exports during the coming decade.

Soybean oil exports from Argentina are projected to climb to 5.8 million tonnes by 2024-25, a 34 per cent increase from 2015-16. Argentina's strength as a soybean oil exporter reflects the country's large crushing capacity, its small domestic market for soybean oil, and an export tax structure that favours exports of soybean products rather than soybeans. Although Argentina's soybean oil exports rise, growth will slow down as more soybean oil will be used to produce biodiesel.

Brazil's projected increase in annual soybean oil exports accounts for much of the rest of the global increase in soybean oil trade. Brazil is projected to use more soybean oil for biodiesel production, but the expansion of soybean production into new areas of cultivation is expected to enable the country to increase soybean oil exports as well.

US soybean oil exports are projected to rise steadily in the projections and reach 1.4 million tonnes in 2024-25. The United States is expected to remain the world's third-largest soybean oil exporter.

FAPRI

FAPRI projects global soybean oil trade at 10.3 million tonnes in 2021, close to the USDA projection of 10.8 million tonnes. Continuing the trend that started with its biodiesel blending mandate, Brazil's exports of soybean oil is expected to decline throughout the outlook period, finishing at only 584,000 by 2025-26.

World trade in rapeseed/mustard oil is projected to go up with net exports increasing by 31 per cent by 2025. China and the EU combined account for 86 per cent of the expansion in net imports. On the supply side, Canada provides 60 per cent of the growth in net exports, maintaining its market share at about 65 per cent. Ukraine continues to consolidate its position as the second largest exporter.

Ukraine maintains its dominant position as the largest net exporter of sunflower and sunflower seed oil. By 2025-26, the country is projected to hold a 66 per cent share of the net export markets for sunflower oil.

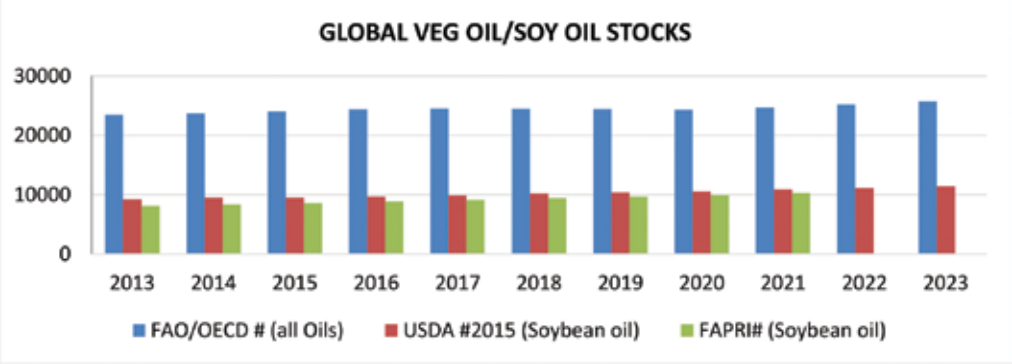
Palm oil remains the world's lowest-cost, most abundant, and most traded vegetable oil. Indonesia and Malaysia are the major exporters while China, India, and the EU dominate the demand side of the market. Increasing incomes in China and India result in higher consumption of vegetable oils, including palm oil, which translates into growing import demand. The net imports of China and India are projected to grow by 78 per cent and 54 per cent respectively over the outlook period. Indonesia is expected to expand its leadership as the world's largest producer and exporter over the outlook period.

Among other traded oils, peanuts oil trade is projected to remain relatively stable albeit at a low level, with only 2 per cent of the produced quantities of peanut oil traded internationally.

IGC projections do not cover vegetable oils.

II.3.5.d Stocks

Figure II.24: Global Vegetable Oil/Soy Oil Stocks (Thousand Metric Tonnes)



Carryover stock level of total vegetable oils is projected to register a steady albeit modest growth over the projection period, reaching 25.7 million tonnes in 2023, an increase of about 10 per cent.

OECD/FAO

Carryover stock level of total vegetable oils is projected to register a steady albeit modest growth over the projection period, reaching 25.7 million tonnes in 2023, an increase of about 10 per cent.

USDA

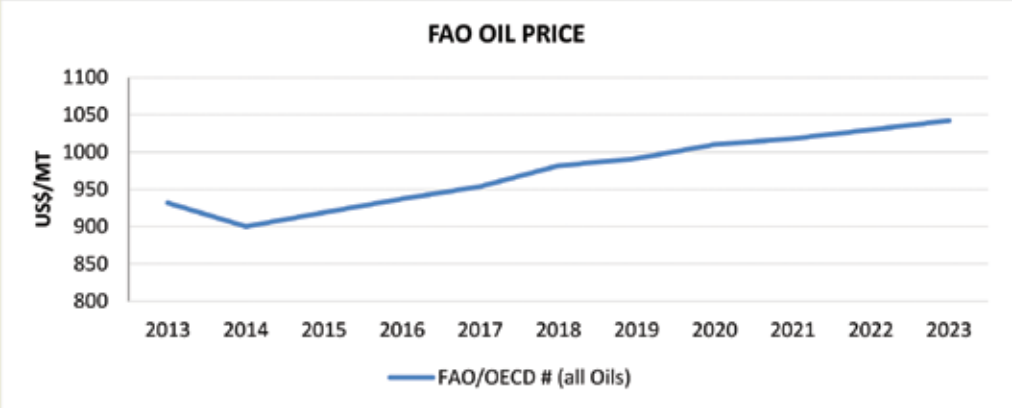
Global stocks have increased for most commodities, including vegetable oils, during the past few years as world production has increased faster than use, increasing stocks and easing price levels. USDA projection, which covers only soybean oil, places global soybean oil stocks at 11.4 million tonnes by 2023, registering a growth of 24 per cent during the projection period.

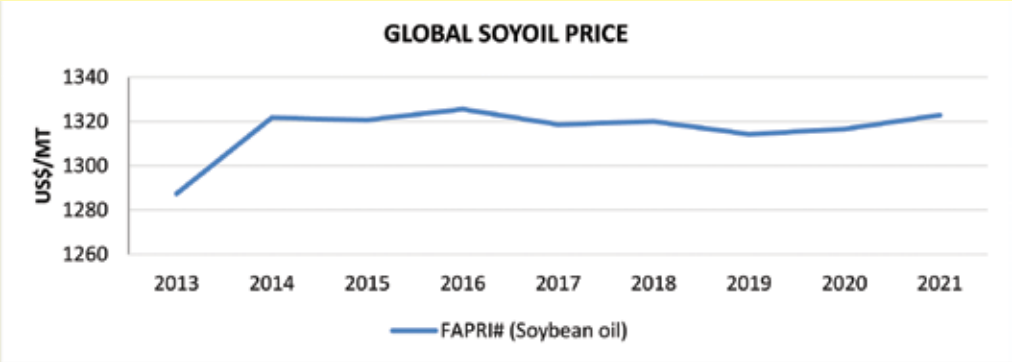
FAPRI

FAPRI projects soybean oil stocks at 10.3 tonnes in 2021, somewhat lower than the USDA projection for 2021, increasing from 8.1 million tonnes in 2013, an increase of 27 per cent.

II.3.5.e Price

Figure II.25: Global Oil Price





After the initial downward correction, all prices of the oilseed complex are expected to increase over the medium term due to strong demand for vegetable oils and protein meal.

OECD/FAO

After the initial downward correction, all prices of the oilseed complex are expected to increase over the medium term due to strong demand for vegetable oils and protein meal. The demand for protein meals is mainly driven by the growth in non-ruminant

population (poultry, fish, sheep, goat and pig), milk production in developing countries and a greater incorporation rate of protein in feed ration in these countries. Vegetable oil demand is mainly driven by food and biodiesel sector. The price of vegetable oils and oil meal in 2023 will be respectively 30 per cent and 46 per cent higher than in real terms from the base period. OECD/FAO indicative price of vegetable oils is projected at US$1,042 per metric tonne.

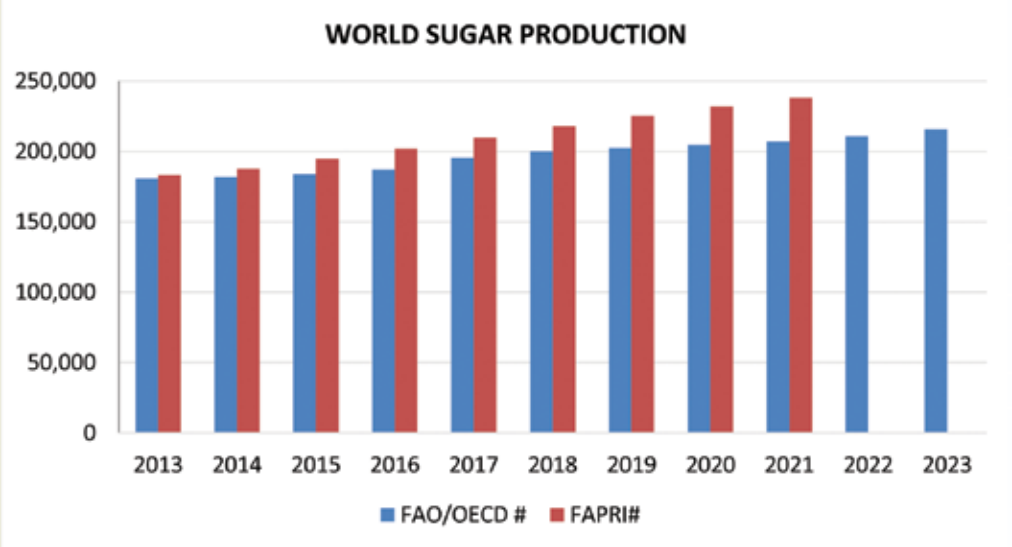
FAPRI

Driven by strong demand for food and industrial uses, the price of soybean oil is projected to rise for most of the period reaching US$ 1322.8 per tonne in 2021.

II.3.6 Sugar

II.3.6.a Production

Figure II.26: Global Sugar Production (Thousand Metric Tonnes)



OECD/FAO

World sugar production is projected to increase by 1.9 per cent per annum over the projection period to reach nearly 216 million tonnes by 2023, an increase of about 36 million tonnes over the base period with most of the increase confined to countries producing sugarcane, like India, rather than sugar beet. The projected increase in production is attributed to higher yields rather than area expansion.

There has been a slowdown in the rate of expansion in processing capacity in recent years until 2013. Despite some slowdown in production growth at the beginning of the outlook period, returns to sugar production are expected to remain sufficiently remunerative on average and will encourage further investment and increased production over the coming decade.

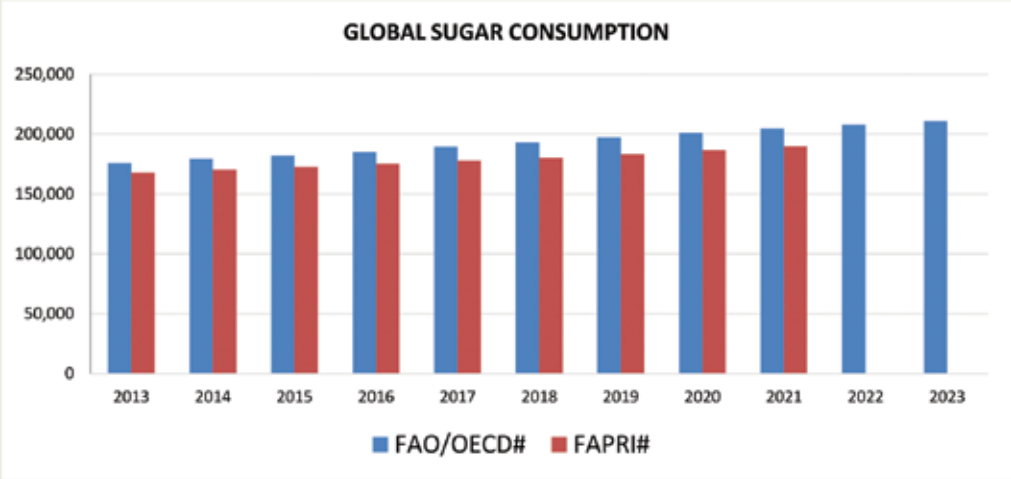
World sugar production is projected to increase by 1.9 per cent per annum over the projection period to reach nearly 216 million tonnes by 2023, an increase of about 36 million tonnes over the base period

FAPRI

World sugar production is projected to increase by 30 per cent during the projection period to 238 million tonnes in 2021, which is significantly (31 million tonnes) above the OECD/FAO projection as the reported data could be on raw sugar basis instead of OECD/FAO's projections on white sugar basis.

II.3.6.b Consumption

Figure II.27: Global Sugar Consumption (Thousand Metric Tonne)



Global consumption of sugar is projected to grow at an annual compound growth rate of around 1.9 per cent, slightly slower than in the previous decade to reach 211 million tonnes by 2023.

OECD/FAO

World sugar demand will be influenced by the recovery of global economic growth and the slightly lower growth in world population over the coming decade. Global consumption of sugar is projected to grow at an annual compound growth rate of around 1.9 per cent, slightly slower than in the previous decade to reach 211 million tonnes by 2023. Developing countries as a group, with their dominant share of world sugar use, will continue to display the fastest growth in demand, driven by rising income, urbanisation, and growing population. In contrast, sugar consumption is projected to show little or no growth in many of the developed countries consistent with their status as mature or saturated sugar markets. Slowly growing and ageing populations along with increased health consciousness and dietary changes are factors that have led to a decline in sugar use in these countries. China and India will experience the biggest increase in sugar consumption, but the growth in terms of per capita consumption is expected to be highest in China.

FAPRI

World sugar consumption is projected to increase by 13 per cent during 2013-14 through 2021-22 to reach 190 million tonnes, somewhat lower than the OECD/FAO projection of around 205 million tonnes.

II.3.6.c Trade

Figure II.28: Global Sugar Trade (Thousand Metric Tonnes)

*FAPRI trade data does not include inter-regional trade.

OECD/FAO

Over the coming decade, developments in some sugar producing countries known as deficit countries will provide a change in the pattern of global imports. This is the case with the European Union, where the sugar quota will be abolished in 2017. From then on, more sugar beet will be devoted to sugar production for human consumption, which is more profitable than ethanol production, and this will impact sugar imports by the EU. Thus, the EU is expected to lose its position as the world's largest importer with imports projected to decline to 1.9 million tonnes in 2023 compared to the base period. In the Russian Federation too, a decrease in sugar imports is anticipated over the projection period as growth in sugar production, combined with a decline in population, should help reduce the deficit and lead to lower imports.

Asia-Pacific and Africa will see the strongest growth in sugar demand, driving the growth in imports for those two regions. Imports by the United States at an average annual level of 3.2 million tonnes of imports is expected over the projection period, making the United States the second largest importer world-wide in 2023 after Indonesia. Continuation of Tariff Rate Quota (TRQ) imports from third countries as well as from Mexico as part of a fully integrated market under NAFTA should bolster imports to bridge the supply-demand gap. China is expected to remain the third largest importer of sugar.

Sugar exports are expected to remain highly concentrated with Brazil keeping its position as the largest exporter, accounting for about 48 per cent of world trade in 2023, up from 45 per cent during the base period. Good prospects are considered for the world's second largest exporter Thailand, where export availability is expected to increase by 2.4 million tonnes over the outlook period because of an anticipated significant increase in sugar production, thanks to investment in new irrigation scheme

Asia-Pacific and Africa will see the strongest growth in sugar demand, driving the growth in imports for these two regions.

and technologies. Australian sugar exports are anticipated to increase by nearly 850,000 tonnes to reach 4 million tonnes in 2023.

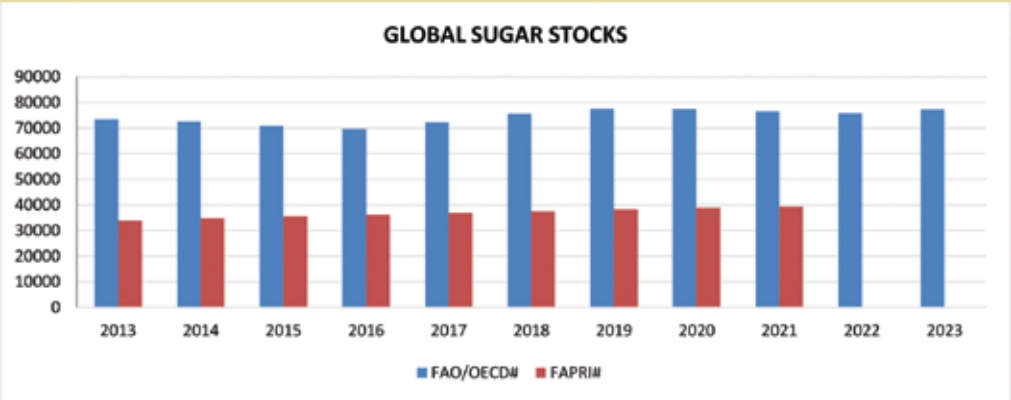
India, as the world's second largest sugar producer and the leading sugar consumer, exerts an important influence on the world sugar market. Sugar production has followed a cyclical pattern in India with periods of surplus followed by periods of deficits and this cyclical production pattern is projected to continue over the projection period making India a significant sugar importer in some years and a small periodic exporter in other years of the coming decade.

FAPRI

By 2025-26, net sugar exports are projected to increase for all major exporters – by 52 per cent for Brazil, 9.5 per cent for Australia, 22.4 per cent for Thailand, and 28.3 per cent for Guatemala. Over the projection period, net imports are projected to increase for all major importers except Russia and Japan, where net imports will decline by 14.4 per cent and 11.4 per cent respectively. India follows its historical pattern of switching from net importer to net exporter and back to net importer by the end of the projection period.

II.3.6.d Stocks

Figure II.29: Global Sugar Stocks (Thousand Metric Tonnes)



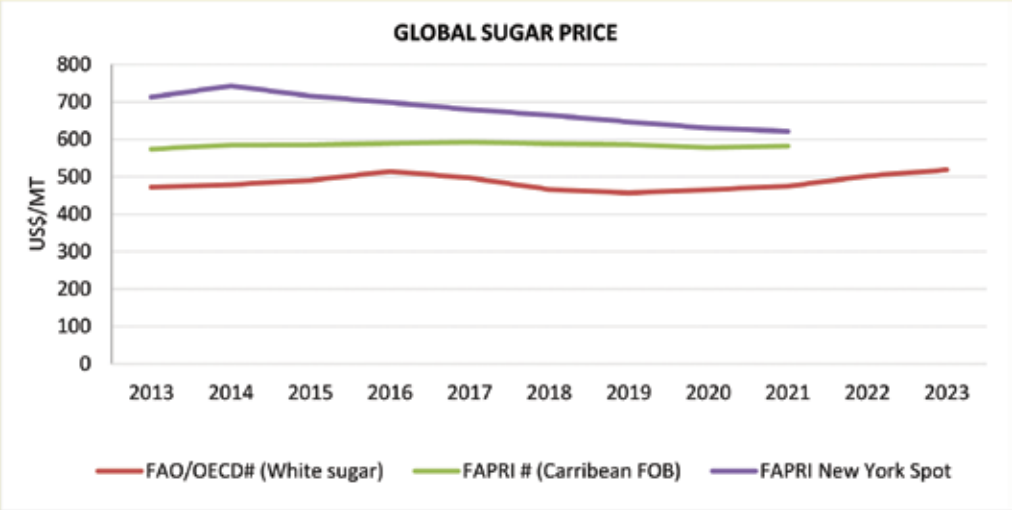
OECD/FAO

There has been a large accumulation of stocks in many countries since the beginning of the surplus phase in 2011. Global stocks and the stocks-to-use ratio have reached a six-year high at the start of the outlook period. World sugar stocks, on average, are not foreseen to decline but stocks-to-use ratio will, as countries respond to lower prices with increasing consumption.

Typically, **FAPRI** sugar stocks projection is significantly below the OECD/FAO stocks projection. According to the FAPRI projection, global sugar stocks are placed at 39 million tonnes in 2021, just half of OECD/FAO projection of 76.4 million tonnes in that year. The reason for this large difference needs explanation.

II.3.6.e Price

Figure II.30: Global Sugar Price



OECD/FAO

Global sugar prices are expected to continue to remain volatile during the projection period, but will edge moderately upward on the back of rising costs of production. Both raw and white sugar prices are expected to follow a similar pattern over the projection period. The raw sugar price (International Exchange No 11 contract nearby futures) is projected to reach US$431 per tonne in nominal terms in 2023. The indicator world white sugar price (Euronext, Liffe futures contract No.407, London) is projected to reach US$ 519 per tonne in nominal terms in 2023. The white sugar premium is projected to narrow over the coming decade to reach US$95 per tonne. World sugar prices are expected to average higher over the projection period but to continue to decline in real terms. Large stocks weighing on the market at the start of the outlook period are expected to slow price recovery. Cost of production in Brazil and the allocation of its large sugarcane crop between sugar and ethanol production remains a key determinant of world sugar prices over the outlook period. Production and consumption of and trade in high fructose corn syrup (HFCS) are also likely to impact price sentiments.

FAPRI

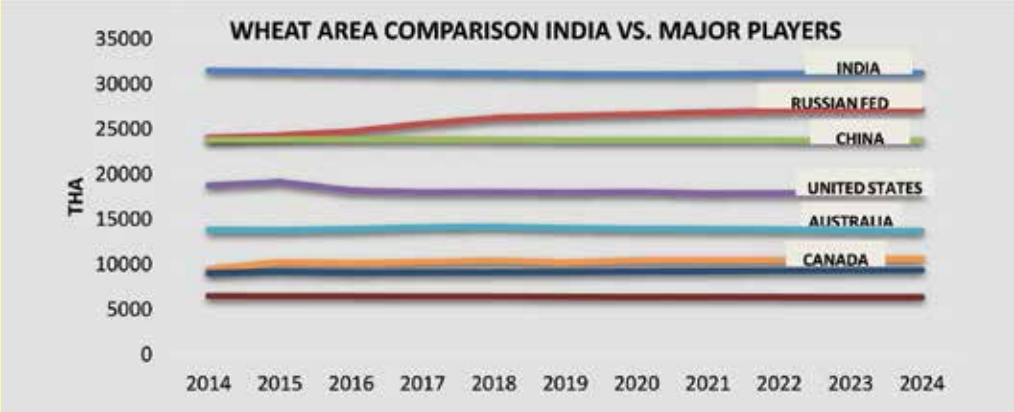
World sugar prices are projected to remain high throughout the projection period but begin to decline in 2020-21, reaching 23.2¢ per pound (US$ 511 per tonne) by 2025-26.

II.4 Projected Trend and Growth Rates in Area and Yield of Selected Food Crops: India vs. World and Major Global Players

The following charts depict projected India's relative position in area and production vis-à-vis world and other major global players. Unlike other charts and analysis, which were based on the OECD-FAO Agricultural Outlook 2014-23, these are based on the latest edition (2015) of the OECD-FAO Agricultural Outlook 2015-2024[11].

[11]http://www.agri-outlook.org/publication/#d.en.349745

Figure II.31: Wheat Area and Yield Comparison India vs. Major Players



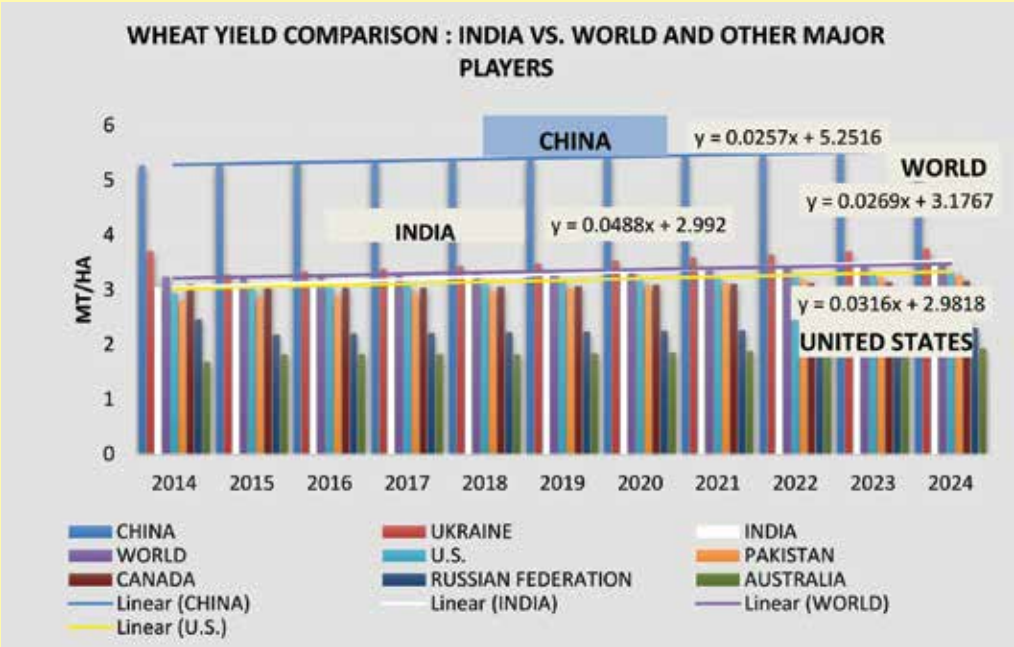
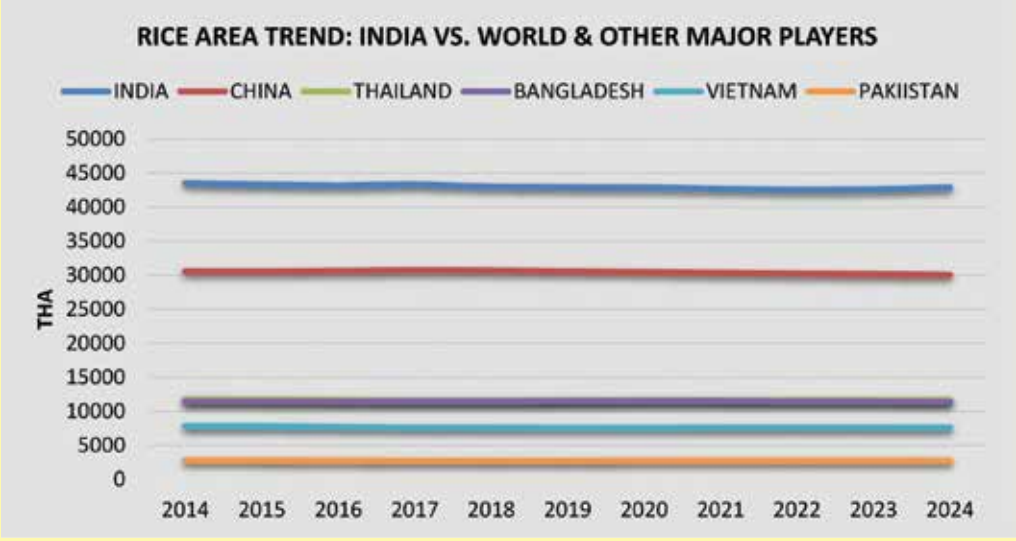


Figure II.32: Rice Area and Yield Comparison India vs. Major Players



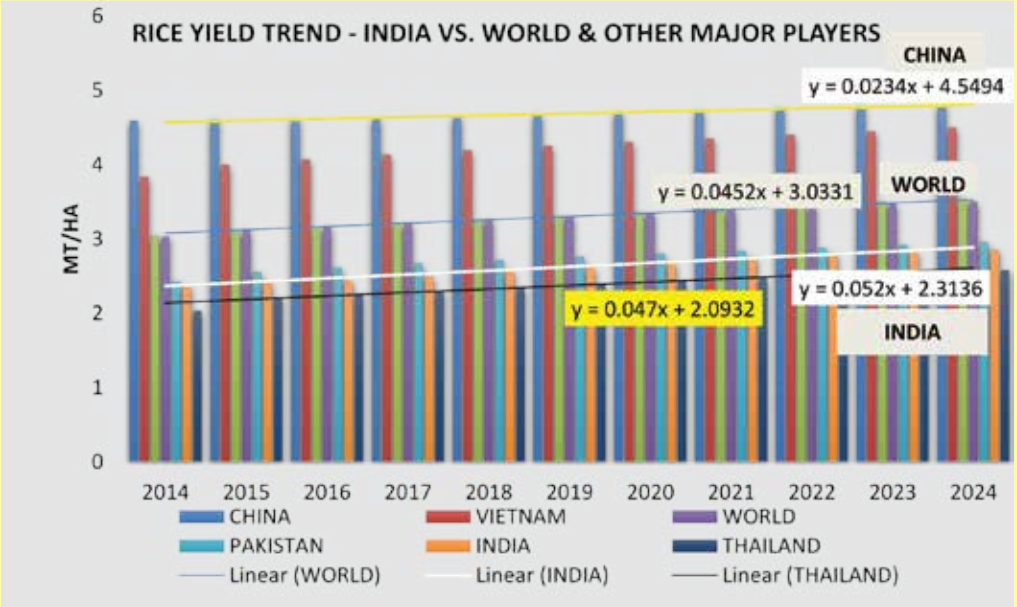
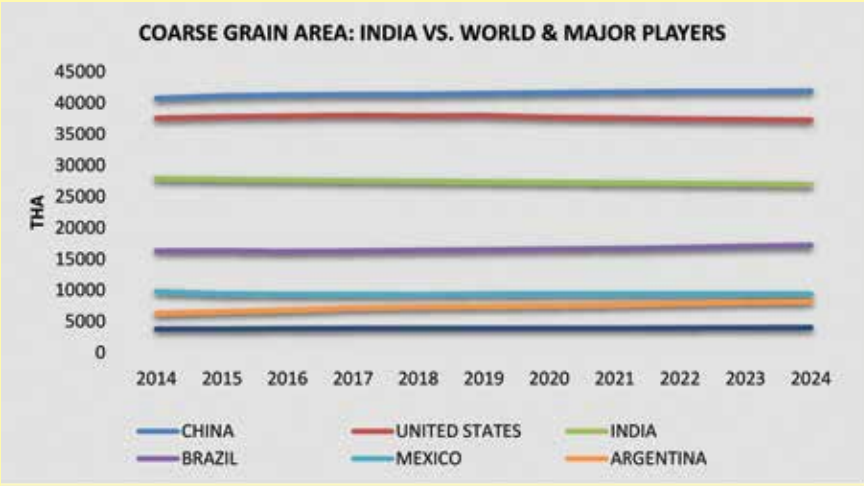


Figure II.33: Coarse Grains Area and Yield Comparison India vs. Major Players



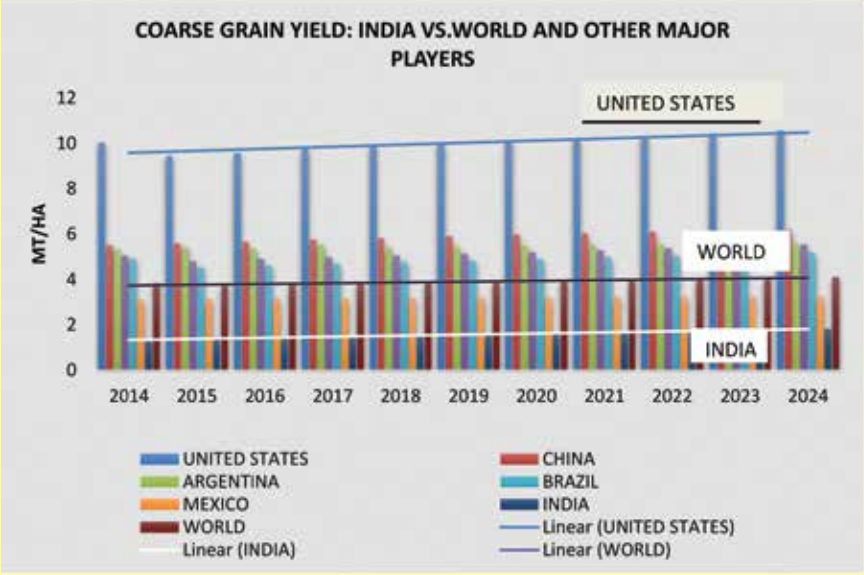
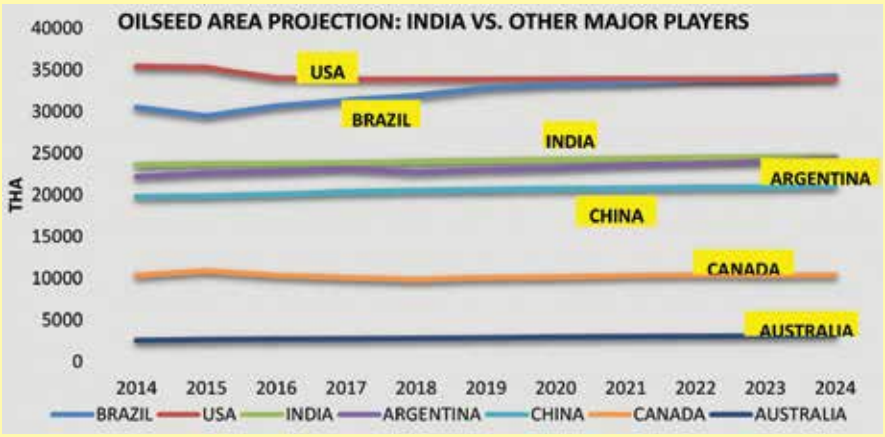


Figure II.34: Oilseeds Area and Yield Comparison India vs. Major Players



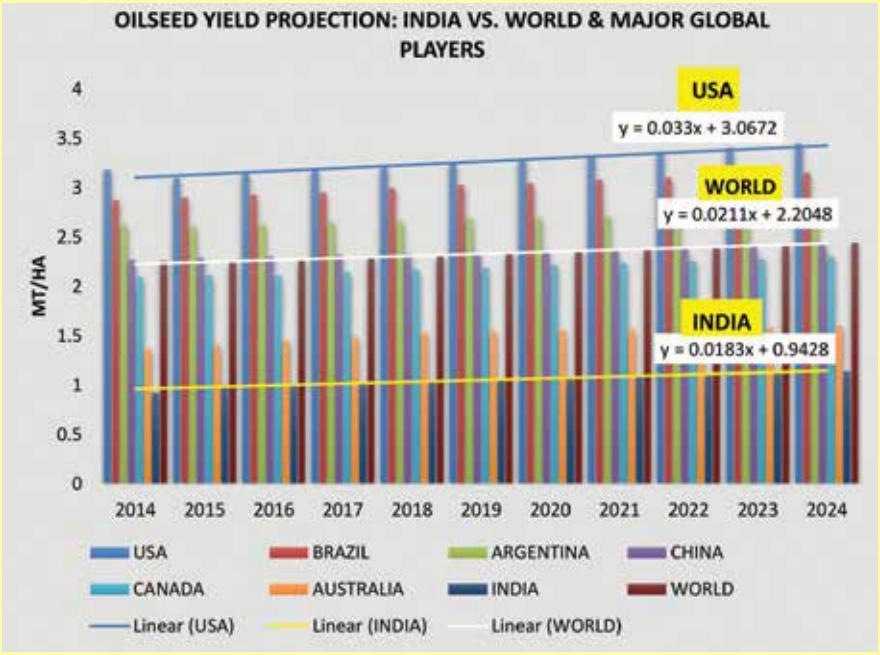
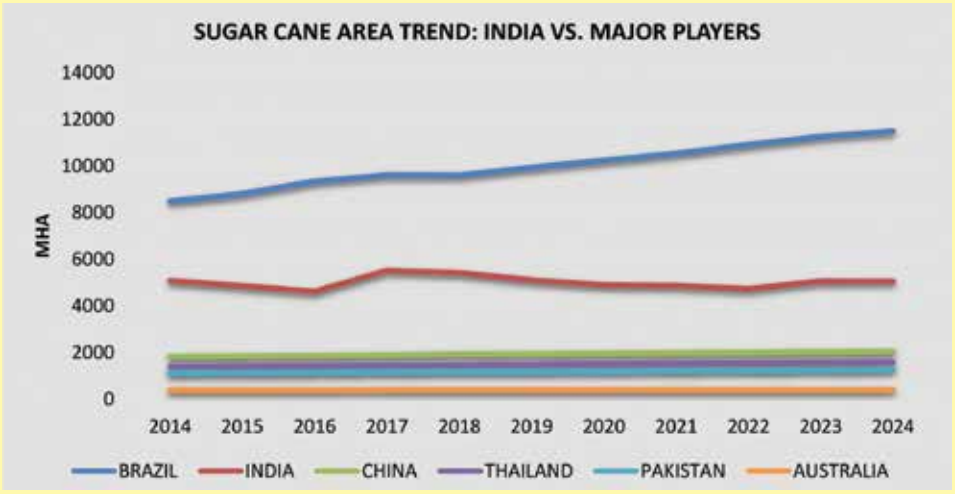
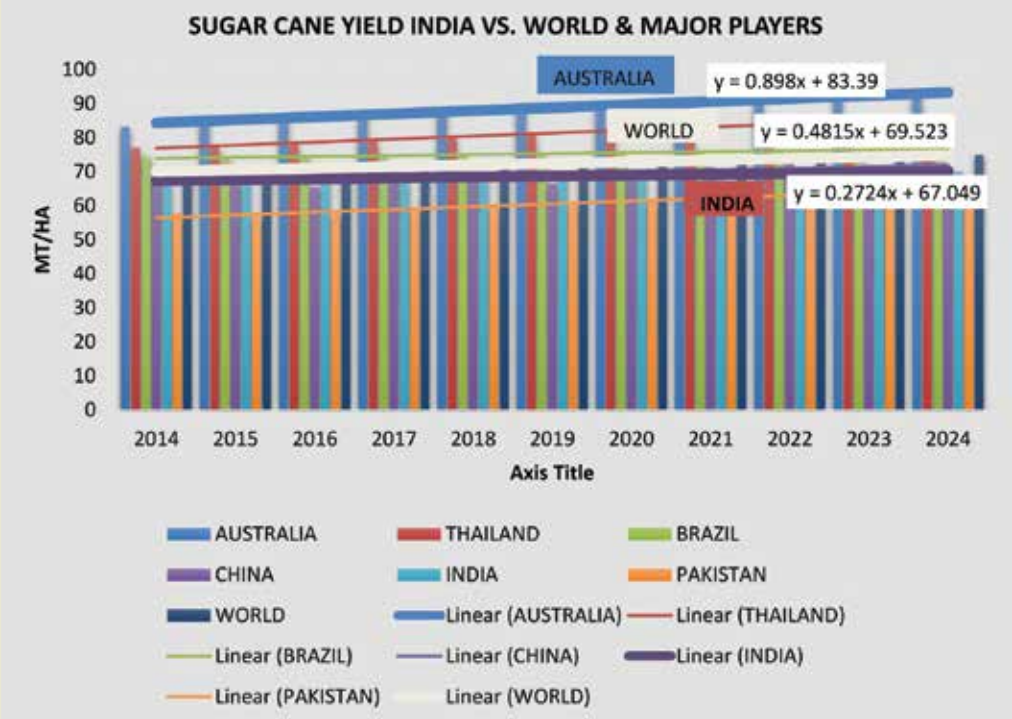


Figure II.35: Sugar cane Area and Yield Comparison India vs. Major Players




SUGAR CANE YIELD INDIA VS. WORLD & MAJOR PLAYERS
AUSTRALIA
y = 0.898x + 83.39
WORLD
y = 0.4815x + 69.523
INDIA
y = 0.2724x + 67.049
MT/HA
100
90
80
70
60
50
40
30
20
10
0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
Axis Title
AUSTRALIA
THAILAND
BRAZIL
CHINA
INDIA
PAKISTAN
WORLD
Linear (AUSTRALIA)
Linear (THAILAND)
Linear (BRAZIL)
Linear (CHINA)
Linear (INDIA)
Linear (PAKISTAN)
Linear (WORLD)

CHAPTER III

Medium-term Outlook for India Food Commodity Sector

III.1 Comparison of Medium Term Projections by Various Agencies

As indicated in chapter two of the report, four institutions namely, FAO/OECD, ERS/USDA, FAPRI and IGC have come out with their medium term projections for Global agricultural outlook which includes projections for India also. In this chapter a comparative analysis of the Global and Indian agricultural outlook has been provided.

III.1.1 Wheat

Table III.1: Comparison of Annual Compound Growth Rates of Wheat (%) Projected by Various Agencies

Parameter	Global/India	FAO/ OECD	USDA	FAPRI	IGC
Production	Global	0.92	0.67	1.03	0.44
	India	1.54	0.77	1.11	1.04
Consumption	Global	1.09	0.74	1.05	0.72
	India	1.68	0.63	1.15	1.52
Trade	Global	1.16	1.15	2.12	-0.02
	India	-1.66	-4.67	5.77	-99.28
Stocks	Global	1.39	0.84	0.76	0.02
	India	2.13	0.78	0.74	0.78
Per capita Consumption	Global	-0.21	NA	NA	NA
	India	0.50	NA	NA	NA
Price	Global	-0.58	NA	NA	NA
	India	4.02	NA	NA	NA

Note: Please note that these growth rates are not comparable in absolute terms and are only indicative as the commodity coverage and projection period are different for various agencies. For (FAO/ OECD =2013 to 2023 (11 years); USDA =2013 to 2023 (11 years)); FAPRI = 2013-2021 (9 years) and IGC =2013-2019 (7 years).

a) **Production:** The projected annual production growth rate by various agencies, although different in magnitude, generally agree that India's production growth rate will be higher than the global growth rate **(Table III.1).** OECD/FAO is most optimistic with production projected at 112 million tonnes by 2023 growing by 1.54 per cent per annum, mostly due to yield growth, compared to the global growth rate of 0.92 per cent.

OECD/FAO is most optimistic with production projected at 112 million tonnes by 2023 growing by 1.54 per cent per annum, mostly due to yield growth, compared to the global growth rate of 0.92 per cent.

Total wheat consumption projected by OECD/FAO for 2023 is 103 million tonnes.

b) **Consumption:** Wheat consumption growth rate in India is also projected to be mostly higher than the global growth rate by most agencies, except FAPRI (Table III.1). Total wheat consumption projected by OECD/FAO for 2023 is 103 million tonnes (Appendix-Fig 2). With the policy on demand oriented towards increasing consumption of cereals to enhance food security such as the National Food Security Act (NFSA), OECD/FAO projects per capita wheat consumption in India to reach 65.5 kg/year in 2023 compared to 61.7 kg/year in 2013, approaching the global per capita wheat consumption level of 66.2 kg/year.

c) **Trade:** While year-on-year growth in global wheat trade is projected to remain positive, albeit modestly by most agencies, India's wheat exports growth is projected to decline significantly by some agencies (**Table III.1**). FAPRI projects India to be a small exporter with miniscule imports in 2016. IGC projects India to be a net importer, albeit small, of wheat from 2017.

d) **Stocks:** Except OECD/FAO, which projects Indian wheat stocks to grow at a higher annual rate of 2.18 per cent compared to 1.39 per cent globally, most other agencies project a lower growth rate of around 0.78 per cent in Indian wheat stocks (**Table III.1**). Their projection of the growth rate in global stocks is also much lower than the OECD/FAO growth rate ranging from 0.84 per cent by USDA to 0.02 per cent by IGC. However, OECD/FAO projects India wheat stocks at 28 million tonnes in 2023 (**Appendix-Fig 5**), growing at 2.13 per cent per annum.

e) **Price:** While OECD/FAO projects a year-on-year (y-o-y) growth rate of wheat prices globally in dollar terms at -0.58 per cent, wheat price in India is projected to grow at 4 per cent annually in rupee terms (**Table III.1**) reaching Rs. 24,397 per tonne in 2023. No other agencies have projected prices, either globally or for India (**Appendix-Fig 6**).

III.1.2 Rice

Table III.2: Comparison of Annual Compound Growth Rates of Rice (%) Projected by Various Agencies

Parameter	Global/India	FAO OECD	USDA	FAPRI	IGC
Production	Global	1.17	0.84	NA	0.92
	India	1.46	0.76	NA	1.91
Consumption	Global	1.18	0.79	NA	0.80
	India	1.43	0.58	NA	1.94
Trade	Global	2.83	1.64	NA	1.66
	India	1.13	-1.29	NA	-5.08
Stocks	Global	0.91	0.76	NA	-2.21
	India	2.13	0.78	NA	0.78
Per capita Consumption	Global	0.13	NA	NA	NA
	India	0.27	NA	NA	NA
Price	Global	0.66	NA	NA	NA
	India	5.04	NA	NA	NA

Note: Please note that these growth rates are not comparable in absolute terms and are only indicative as the projection period are different for various agencies. For (FAO/ OECD =2013 to 2023 (11 years); USDA =2013 to 2023 (11 years)); FAPRI = 2013-2021 (9 years) and IGC =2013-2019 (7 years).

a) **Production:** The projected annual rice production growth rate of 1.46 per cent by OECD/FAO and 1.91 per cent by the IGC for India are higher than the global growth rate of 1.17 per cent and 0.84 per cent respectively by these agencies **(Table III.2).** As in the case of wheat, OECD/FAO projection is the most optimistic with production projected at 124 million tonnes by 2023 (**Appendix-Fig 7**), growing at a rate of 1.4 per cent per annum led by a yield growth rate of 1.9 per cent per annum. Several government programmes such as the *National Food Security Mission* (NFSM), *Rashtriya Krishi VikasYojana* (RKVY), and *Bringing Green Revolution in Eastern India* (BGREI) to increase production and productivity, supported by anticipated higher support prices to farmers in line with the cost of production, are factors likely to contribute to higher yield growth in India. The USDA's projection of an annual growth rate of 0.76 per cent to take production to 112.5 million tonnes by 2023, is the most pessimistic. FAPRI projections do not cover rice. IGC projection, although available only up to 2019, of production at 116 million tonnes, is more or less in line with OECD/FAO projection of 117 million tonnes in 2019.

The projected annual rice production growth rate of 1.46 per cent by OECD/FAO and 1.91 per cent by the IGC for India are higher than the global growth rate of 1.17 per cent and 0.84 per cent respectively by these agencies

b) **Consumption:** The growth rate of rice consumption in India is projected to be higher than the global growth rate by OECD/FAO and IGC at 1.43 per cent (global 1.18 per cent) and 1.94 per cent (global 0.8 per cent), respectively, whereas the USDA projects a lower than global rice consumption growth rate for India at 0.58 per cent. As in the case of wheat, with government policies such as the NFSA focused on increasing consumption of cereals to enhance food security, OECD/FAO projects per capita rice consumption in India to reach 78 kg/year in 2023, compared to 75.2 kg/year in 2013, about 20 kg/year above the global per capita rice consumption level of about 58 kg/year (**Appendix-Fig 8**).

The growth rate of rice consumption in India is projected to be higher than the global growth rate by OECD/FAO and IGC at 1.43 per cent (global 1.18 per cent) and 1.94 per cent (global 0.8 per cent),

c) **Trade:** Global rice trade y-o-y growth is projected at 2.83 per cent by OECD/FAO at 49.1 million tonnes in 2023, 1.64 per cent by USDA at 46.8 million tonnes also in 2023, and 1.66 per cent by IGC at 44.3 million tonnes in 2019 (**Table III.2**). However, Indian net rice exports growth are projected much below the annual global growth rate at 1.13 per cent at 8.7 million tonnes by OECD/FAO in 2023, and an annual negative growth rate of 1.29 per cent by the USDA at 8.2 million tonnes in 2023 (**Appendix-Fig 9**). IGC also projects a negative growth rate of 5.1 per cent at 6.9 million tonnes in 2019. This is due to increased competition from other traditional exporting countries such as Thailand and Vietnam, and new emerging exporters such as Myanmar and Cambodia.

d) **Stocks:** Indian rice stocks are projected to increase at a higher annual growth rate of 2.13 per cent by OECD/FAO to 26.2 million tonnes compared to the growth rate of 0.91 per cent in global rice stocks during the projection period ending 2023, placed at 198.8 million tonnes. However, USDA estimates Indian rice stocks to increase by a modest 0.76 per cent annually to17.6 million tonnes, equal to the global rice stocks growth rate, to 112.3 million tonnes. IGC's projection of the growth rate of Indian rice is 0.78 per cent at 11.9 million tonnes in 2019 is significantly above its global rice stocks growth rate of -2.21 per cent at 95.4 million tonnes in 2019. The IGC's projected 2019 Indian rice stocks are significantly below the OECD/FAO's stocks projection of 24.7 million tonnes and USDA's stocks projection of 15.2 million tonnes in 2019 (**Appendix-Fig 10**).

e) **Price:** OECD/FAO projects the price of rice in nominal terms to increase steadily at 5 per cent per annum in India (**Table III.2**) to Rs. 42,511 per tonne by 2023 (**Appendix-Fig 11**) compared to an indicative global price increase of 0.7 per cent to $391 per tonne (in real terms). Global rice prices over the projected period are expected to follow the recent trend since 2011 and slide further down to touch US$391 per tonne in nominal terms in 2023, reflecting large supplies accumulated earlier in this decade, particularly in exporting countries in Asia. This will take long to offload on the market and will weigh on international prices at least until 2015. After this drop, the nominal rice price is projected to recover but to continue to fall in real terms. Other agencies have not projected global and international prices.

III.1.3 Coarse Grains/Maize

Table III.3: Comparison of Annual Compound Growth Rates of Coarse Grains/Maize (%) of TCG Projected by Various Agencies

Parameter	Global/India	FAO OECD	USDA	FAPRI	IGC
Production	Global	1.17	1.34	1.62	0.85
	India	1.75	2.26	1.91	1.80
Consumption	Global	1.31	1.56	1.60	0.92
	India	1.50	3.11	2.28	NA
Trade	Global	1.85	1.34	2.88	0.19
	India	5.17	-5.31	-2.69	3.14
Stocks	Global	1.12	1.58	1.72	1.62
	India	2.27	1.45	3.39	NA
Per capita Consumption	Global	-0.21	NA	-0.04	NA
	India	-0.20	NA	0.02	NA
Price	Global	1.44	NA	-0.87	NA
	India	1.50	NA	6.01	NA

Note: Please note that these growth rates are not comparable in absolute terms and are only indicative as the projection period are different for various agencies. For (FAO/ OECD =2013 to 2023 (11 years); USDA =2013 to 2023 (11 years)); FAPRI = 2013-2021 (9 years) and IGC =2013-2019 (7 years).FAO/OECD total coarse grain apparently includes all coarse grains such as maize, sorghum, barley, oats, rye and types of millets. USDA Total coarse grains include maize, sorghum and barley; FAPRI maize and sorghum and IGC maize, barley, sorghum, and other coarse grains (not defined).

All the agencies project Indian coarse grain production to grow at an annual compound growth well above the global total coarse grain growth rate, mostly driven by maize.

a) **Production:** All the agencies project Indian coarse grain production to grow at an annual compound growth well above the global total coarse grain growth rate **(Table III.3)**, mostly driven by maize **(Table III.4).** OECD/FAO projects Indian total coarse grain production to grow at an annual compound growth rate of 1.75 per cent against 1.17 per cent globally to reach 48.7 million tonnes by 2023 (**Appendix-Fig 12**). The USDA projections are more optimistic about India with an annual compound growth rate of 2.26 per cent compared to 1.34 per cent globally. Both FAPRI and IGC also project a higher growth rate for total coarse grains for India at 1.91 per cent and 1.80 per cent respectively, compared to the corresponding global production growth rate of 1.62 per cent and 0.85 per cent.

Table III.4: Comparison of Annual Compound Growth Rates (%) of Maize Projected by Various Agencies

Parameter	Global/India	FAO OECD	USDA	FAPRI	IGC
Production	Global	NA	1.46	1.66	0.80
	India	NA	3.00	2.17	1.03
Consumption	Global	NA	1.71	1.64	1.53
	India	NA	4.01	2.72	NA
Trade	Global	NA	1.57	2.83	1.79
	India	NA	-5.02	-3.79	3.14
Stocks	Global	NA	1.80	1.83	-2.59
	India	NA	3.59	3.44	NA
Per capita Consumption	Global	NA	NA	NA	NA
	India	NA	NA	0.55	NA
Price	Global	NA	NA	-0.01	NA
	India	NA	NA	NA	NA

Note: Please note that these growth rates are not comparable in absolute terms and are only indicative as the projection period are different for various agencies. For (FAO/ OECD =2013 to 2023 (11 years); USDA =2013 to 2023 (11 years)); FAPRI = 2013-2021 (9 years) and IGC =2013-2019 (7 years).

Taking maize alone, USDA, FAPRI, and IGC project annual production growth rate of 3 per cent, 2.17 per cent and 1.03 per cent respectively for India, compared to the global growth rate of 1.46 per cent, 1.66 per cent and 0.80 per cent respectively (**Table III.4**). Production has been projected to touch 30 million tonnes by USDA in 2023, 26.2 million tonnes by FAPRI in 2021 and 24.2 million tonnes in 2019 by IGC (**Appendix-Fig 13**)

b) **Consumption:** India's total coarse grain consumption growth rate is projected to outpace global consumption growth by all agencies (**Table III.3 and Table III.4).** OECD/FAO projects Indian total coarse grain consumption to grow at 1.75 per cent per annum to 43 million tonnes, compared to 1.17 per cent globally to touch 1,395 million tonnes. However, on a per capita basis, Indian coarse grain consumption (human) is projected to remain significantly below the world per capita consumption. For maize, India's total consumption (human and feed) is projected to grow annually at 4 per cent by USDA to touch 28.1 million tonnes in 2023 and at 2.72 per cent by FAPRI to touch 25 million tonnes in 2019.

c) **Trade:** OECD/FAO projections are highly optimistic about India's total coarse grain exports, mainly consisting of maize and small quantities of barley and sorghum in the medium term. At an annual growth rate of 5.2 per cent during the projection period (**Table III.3**), exports are projected to reach 5.6 million tonnes in 2023; this is only a miniscule share of the global trade of 165 million tonnes. Other agencies, except IGC, are rather pessimistic about India's total coarse grain exports with the USDA projecting a negative annual growth rate of 5.3 per cent amounting to 2.4 million tonnes in 2023 and FAPRI projecting an annual growth rate of -2.7 per cent amounting to 1.5 million tonnes in 2021. IGC projections are more optimistic at 4.0

OECD/FAO projects Indian total coarse grain consumption to grow at 1.75 per cent per annum to 43 million tonnes, compared to 1.17 per cent globally to touch 1,395 million tonnes.

million tonnes (maize only) by 2019 at an annual growth rate of 3.14, significantly above the global maize trade growth of 0.19 per cent amounting to 153 million tonnes in 2019.

d) **Stocks:** India's coarse grain stocks are typically low and are projected to increase only modestly both by the USDA and FAPRI. However, OECD/FAO projections show a significant growth (2.27 per cent) in India's total coarse grain stocks (Table III.3) to reach 7.7 million tonnes in 2023 compared to 1.5 million tonnes by USDA in 2023 and 1 million tonnes by FAPRI in 2021 (**Appendix-Fig 15**)

e) **Price:** OECD/FAO projects the price of all coarse grains to increase steadily at 1.5 per cent per annum in India to Rs. 25, 281 per tonne in nominal terms by 2023 (**Appendix-Fig 16),** compared to the indicative global price of $225 per tonne (in real terms), an annual increase of 1.44 per cent during the projection period (**Table III.3**).

III.1.4 Total Oilseeds/Soybean

Table III.5: Comparison of Annual Compound Growth Rates (%) of Total Oilseeds/Soybeans Projected by Various Agencies

Parameter	Global/India	FAO OECD	USDA	FAPRI	IGC
Production	Global	1.75	2.14	1.60	1.52
	India	2.63	2.09	0.60	1.25
Consumption	Global	1.92	2.56	1.59	1.91
	India	2.52	2.25	0.59	NA
Trade	Global	1.24	2.72	1.82	2.83
	India	12.71	-1.73	NA	NA
Stocks	Global	-1.38	-0.13	0.64	-1.51
	India	3.95	-2.49	4.50	NA
Per capita Consumption	Global	NA	NA	NA	NA
	India	NA	NA	NA	NA
Price	Global	0.15	NA	-0.78	NA
	India	3.54	NA	NA	NA

Note: Please note that these growth rates are not comparable in absolute terms and are only indicative as the projection period are different for various agencies. For (FAO/ OECD =2013 to 2023 (11 years); USDA =2013 to 2023 (11 years)); FAPRI = 2013-2021 (9 years) and IGC =2013-2019 (7 years). Total oilseeds included in the FAO/OECD projection apparently include all oilseeds such as soybeans, rapeseed/mustard, groundnut, sunflower seed, cotton seed, copra, etc. In the case of the USDA and FAPRI, total oilseeds include only soybeans. Total oilseeds in the case of IGC include soybeans and rapeseed/mustard.

Growing at a compound annual growth rate of 2.63 per cent, OECD/ FAO projects India's total oilseeds production to reach 32 million tonnes by 2023 from 24.6 million tonnes in 2013.

a) **Production:** Growing at a compound annual growth rate of 2.63 per cent (Table III. 5), OECD/FAO projects India's total oilseeds production to reach 32 million tonnes by 2023 from 24.6 million tonnes in 2013 **(Appendix-Fig 17).** The total annual oilseed production growth rate at the global level is 1.75 per cent and will reach 507 million tonnes. Other agencies such as USDA, FAPRI, and IGC project a lower total oilseed production growth rate of 2.1 per cent, 0.6 per cent and 1.25 per cent respectively for India, although these growth rates are not strictly comparable as commodity inclusion in the total oilseed production is different for different agencies.

Taking soybeans only, India's soybean production growing at 2.09 per cent per annum (Table III.6) and is projected to reach 13.6 million tonnes in 2023 by the USDA and 10.8 million tonnes in 2021 by FAPRI (Appendix-Fig 17) (implicit annual growth rate of 0.9 per cent). IGC projects soybean + rapeseed production in India to reach 20.3 million tonnes in 2019 (annual growth rate of 1.7 per cent).

Table III.6: Comparison of Annual Compound Growth Rates (%) of Soybeans Only Projected by Various Agencies

Parameter	Global/India	FAO OECD	USDA	FAPRI	IGC
Production	Global	NA	2.14	1.60	1.64
	India	NA	2.09	0.91	1.70
Consumption	Global	NA	2.56	1.59	2.09
	India	NA	2.25	0.59	NA
Trade	Global	NA	2.72	1.82	3.02
	India	NA	-1.73	NA	NA
Stocks	Global	NA	-0.13	0.64	-1.59
	India	NA	-2.49	4.50	NA
Per capita Consumption	Global	NA	NA	NA	NA
	India	NA	NA	NA	NA
Price	Global	NA	NA	-0.78	NA
	India	NA	NA	NA	NA

Note: Please note that these growth rates are not comparable in absolute terms and are only indicative as the projection period are different for various agencies. For (FAO/ OECD =2013 to 2023 (11 years); USDA =2013 to 2023 (11 years)); FAPRI = 2013-2021 (9 years) and IGC =2013-2019 (7 years).

b) **Consumption/Crush:** OECD/FAO projects India's total oilseed consumption/ crush to grow at 2.52 per cent per annum (**Table III.5**) to 31 million tonnes by 2023 (**Appendix-Fig 18**), compared to the global growth rate of 1.92 per cent to 507 million tonnes. Taking soybeans separately, India's soybean consumption, mostly for crush, is projected to grow at 2.25 per cent per annum by USDA (**Table III.6**) to 13.5 million tonnes by 2023 and 0.59 per cent by FAPRI to 10.7 million tonnes in 2021.

c) **Trade:** FAO/OECD projects India's net total oilseed exports to increase by a massive 12.7 per cent (Table III. 5) to 808,000 metric tonnes, presumably mostly HPS groundnut and small quantities of soybeans and rapeseed/mustard. However, USDA and FAPRI projections, which covers only soybean, shows exports declining or to remain stable during the projection period **(Appendix-Fig 19)**.

d) **Stocks:** OECD/FAO projects India's total oilseed stocks to reach 1.9 million tonnes by 2023 at an annual growth rate of around 4 per cent (**Table III. 5**). USDA and FAPRI projects soybean only stocks at 416,000 by 2023 and 479,000 by 2021, respectively (**Appendix-Fig 20**).

e) **Price:** Price projections are made only by OECD/FAO for total oilseeds (it is unclear which oilseed the price refers to). Indian oilseed price is projected to increase annually by 3.54 per cent to Rs. 51,664 per metric tonne in 2023 from Rs. 34,392 per tonne in 2013 (**Appendix-Fig 21**). This is significantly above the annual rate of

increase in global total oilseed price of 0.15 per cent (Table III.5) to reach $ 522 per metric tonne in real terms.

III.1.5 Vegetable Oils/Soybean Oil

Table III.7: Comparison of Annual Compound Growth Rates (%) of Vegetable Oils projected by Various Agencies

Parameter	Global/ India	FAO OECD	USDA	FAPRI	IGC
Production	Global	2.16	2.87	1.86	NA
	India	2.77	2.49	0.76	NA
Consumption	Global	2.17	2.84	1.87	NA
	India	3.81	2.12	1.97	NA
Trade	Global	2.26	2.14	3.01	NA
	India	3.81	2.12	1.97	NA
Stocks	Global	0.72	1.44	0.98	NA
	India	1.59	-1.03	2.63	NA
Per cap Consum	Global	0.91	NA	0.85	NA
	India	2.69	NA	NA	NA
Price	Global	1.46	NA	0.14	
	India	6.99	NA	NA	NA

Note: Please note that these growth rates are not comparable in absolute terms and are only indicative as the projection period are different for various agencies. For (FAO/ OECD =2013 to 2023 (11 years); USDA =2013 to 2023 (11 years)); FAPRI = 2013-2021 (9 years) and IGC =2013-2019 (7 years) . Total vegetable oils in the FAO/OECD projections apparently include all oils such as soybeans, rapeseed/ mustard, groundnut, sunflower seed, cotton seed, copra, etc. In the case of the USDA and FAPRI, total vegetable oils include only soybean oil. IGC includes soybean oil and rapeseed/mustard oil in total oils.

OECD/FAO projects India's total mmt with million production at 10.3 million tonnes by 2023 at annual growth rate of 2.77 per cent, higher than the global total vegetable oil growth rate of 2.16 per cent.

a) **Production:** OECD/FAO projects India's total mmt with million production at 10.3 million tonnes by 2023 **(Appendix-Fig 22)** at annual growth rate of 2.77 per cent (Table III.7), higher than the global total vegetable oil growth rate of 2.16 per cent. USDA and FAPRI projection covers only soybean oil. The USDA projects India's soybean oil production at 2.1 million tonnes in 2023 at an annual growth rate of 2.49 per annum while FAPRI projects it at 1.7 million tonnes in 2021 at an annual growth rate of 0.76 per cent (**Table III.7**).

b) **Consumption:** OECD/FAO projects total vegetable oil consumption by India to increase by 3.81 per cent per annum (**Table III.7**) to 27.6 million tonnes by 2023. Soybean oil consumption is projected to reach 4.2 million tonnes by USDA in 2023 and 3.1 million tonnes in 2021 by FAPRI (**Appendix-Fig 24**). According to OECD/ FAO projections, on a per capita basis, India's total vegetable oil per capita yearly consumption is projected to increase to 19.4 kg, approaching the global per capita consumption level of 21.1 Kg (**Appendix-Fig 25**). The rise is attributed to increasing per capita income and change in dietary patterns. Indian per capita vegetable oil consumption is projected to grow at 2.69 per cent per annum compared to an annual global per capita consumption growth rate of 0.91per cent.

c) **Trade:** Net oil imports of total vegetable oil by India are projected to increase by 3.81 per cent annually to 17.3 million tonnes in 2023 according to the OECD/FAO, significantly higher than the global vegetable oil trade growth of 2.26 per cent per annum (**Table III.7**), because of a widening supply/demand gap. However, soyben oil imports growth is somwhat lower than the total vegetable oil imports growth , implying a major share of growth in total edible oil imports will be non-soyeban oils, mostly palm oil. USDA projects an annual increase in soybean oil imports by India of 2.12 per cent to 2.2 million tonnes in 2023, whereas FAPRI projects that soybean oil imports by India in 2019 will be 1.44 million tonnes, implying an annual growth rate of 1.97 per cent, somewhat lower than the USDA projection for that year. Growth projections of soybean oil imports by both these agencies are below the growth rate of global trade in soybean oil((**Appendix-Figs 25** & **26**).

d) **Stocks:** OECD/FAO projects total vegetable oil stocks in India to increase by 1.59 per cent per annum to 2 million tonnes by 2023, at a rate faster than the annual growth rate of 0.72 per cent for global veg oil stocks (**Table III.7**).

e) **Price:** Increasing at a rate of 7 per cent per annum, India's indicative vegetable oil prices in nominal terams are projected to skyrocket to Rs. 118, 019 per tonne in 2023, double the price lvel of 58,848 per tonne in 2013 (**Table III.7**), a rate much above the global vegetable oil price growth rate of 1.46 per cent per annum (**Appendix-Fig 30**).

III.1.6 Sugar

Table III.8: Comparison of Annual Compound Growth Rates (%) of Sugar Projected by Various Agencies

Parameter	Global/India	FAO OECD	USDA	FAPRI	IGC
Production	Global	1.87	NA	1.58	NA
	India	2.00	NA	1.75	NA
Consumption	Global	1.88	NA	1.58	NA
	India	2.06	NA	2.28	NA
Trade	Global	1.79	NA	1.25	NA
	India	NC	NA	6.76	NA
Stocks	Global	0.85	NA	1.88	NA
	India	0.69	NA	1.77	NA
Per capita Consumption	Global	0.84	NA	NA	NA
	India	0.97	NA	NA	NA
Price	Global	0.25	NA	0.03	NA
	India	4.79	NA	NA	NA

Note: Please note that these growth rates are not comparable in absolute terms and are only indicative as the projection period are different for various agencies. For (FAO/ OECD =2013 to 2023 (11 years); USDA =2013 to 2023 (11 years)); FAPRI = 2013-2021 (9 years) and IGC =2013-2019 (7 years).

a) **Production:** OECD/FAO projects an annual growth rate of 2 per cent in Indian sugar production to around 31 million tonnes in 2023 from 26.5 million tonnes in 2013, a growth rate somewhat faster than the global sugar production growth rate of 1.87 per cent per annum **(Table III.8).** FAPRI also projects the annual growth

OECD/FAO projects an annual growth rate of 2 per cent in Indian sugar production to around 31 million tonnes in 2023 from 26.5 million tonnes in 2013, a growth rate somewhat faster than the global sugar production growth rate of 1.87 per cent per annum.

India's sugar consumption is projected by OECD/FAO to increase at an annual rate of 2.1 per cent to 32.4 million tonnes from 26.3 million tonnes in 2013.

rate of Indian sugar production at 1.75 per cent, higher than the global production growth rate of 1.58 per cent to around 32 million tonnes in 2021 compared to 30 million tonnes by projected by OECD/FAO in that year (**Appendix-Fig 31**).

b) **Consumption:** India's sugar consumption is projected by OECD/FAO to increase at an annual rate of 2.1 per cent to 32.4 million tonnes from 26.3 million tonnes in 2013. This compared with the FAPRI's projected annual consumption growth rate of 1.58 per cent to 34.5 million tonnes in 2021 from the base level of 27.1 million tonnes in 2013, both at rates higher than the rate of growth of global sugar consumption. Despite increase in total consumption, India's per capita annual sugar consumption is projected by OECD/FAO to remain below the world per capita consumption throughout the projection period.

c) **Trade:** According to OECD/FAO projections, India will remain a net exporter of sugar in some years and net importer in others. Hence, the compound growth rate of net exports cannot be calculated). However, FAPRI projects India to remain a net exporter of sugar during the projection period ending 2021, registering an annual compound growth rate of 6.76 per cent (**Table III.8** and **Appendix-Fig 34**).

d) **Stocks:** OECD/FAO projects India's sugar stocks to grow by around 0.7 per cent annually in a zigzag manner to reach 14.5 million tonnes by 2023. However, FAPRI projects that Indian sugar stocks will grow at a steady rate of 1.77 per cent to reach 8.2 million tonnes in 2021, significantly below the OECD/FAO projection, throughout the projection period.

e) **Price:** Indian sugar prices in nominal terms is projected to increase in a cyclical fashion to reach around Rs. 64,000 per metric tonne in 2023, at an annual compound growth rate of 4.8 per cent (**Table III.8** and **Appendix-Fig 36**), significantly above the indicative global sugar price growth rate of 0.25 per cent to reach $519 per tonne in real terms.

III.2 India Stand-alone COSIMO Model

Summary of COSIMO work in India

In India, work on the COSIMO model is led by the National Council of Applied Economic Research (NCAER) under the Government of India funded project "Agriculture Outlook and Situation Analysis for Food Security". FAO is providing technical assistance to this project through a DFID-funded initiative: "Incorporating International Best Practices in the Preparation of Agricultural Outlooks and Situation Analysis Reports". The main outputs of the project are quarterly, short-term and biannual medium-term outlook reports on the agricultural sector in India. The medium-term outlook reports are based on an econometric model of the food sector developed at NCAER and maintained in collaboration with the Institute of Social and Economic Change (ISEC), Bangalore. However, the model is limited to a few commodities and does not have a clear supply-demand equilibrium framework.

The project enabled India to participate in the World Agricultural Outlook Conference held in Beijing in June 2013, where the lead expert from NCAER, Dr. Shashanka Bhide, presented the work being done in India. This was also an opportunity to interact with experts from various international agencies who were

involved in generating outlooks for the agricultural sector. There were a number of workshops, consultations and exchange of visits by technical experts from FAO and OECD. A workshop was held in November 2012 where two experts from FAO - Dr. Liliana Balbi and Dr. Paul Racionzer - shared the process of preparing Food Outlooks at FAO. Dr. Holger Matthey made a video presentation over skype on the OECD-FAO collaborative work in preparing Agricultural Outlook reports. A follow up visit by FAO-OECD team, comprising Dr. Holger Matthey and Dr. Gregoire Tallard, was undertaken in April-May 2013 to hold discussions with the NCAER team and officials from the Ministry of Agriculture to begin collaborative work on models for medium-term outlook analysis.

During this mission visit, a three-day workshop to present the details of the AGLINK-COSIMO model was held where the NCAER project team, officials from the Ministry of Agriculture, and experts from various think tanks such as the National Centre for Agricultural Economic Policy and Research (NCAP), Institute for Social and Economic Change (ISEC), Institute of Economic Growth (IEG), etc., participated. Following this, a week-long, hands-on training workshop focusing on the AGLINK-COSIMO model was held in September 2013. Technical experts from the NCAER and the Ministry of Agriculture participated in the workshop, which led to a better understanding of the software, data and the models employed in the AGLINK-COSIMO model. The model provides explicit specification of the supply-demand equilibrium and also interactions between domestic and international markets. Such an equilibrium consistency framework is suitable for medium term projections for India. It is also comprehensive in terms of coverage of both crop and livestock commodities and flexible enough to allow incorporation of a number of policy features such as input subsidies, food subsidies, investment expenditures and market reforms with appropriate modification or additions to the model.

The model adapted under the project is an 'India-standalone' version of the global model, and NCAER has the expertise to operate it. The model will now be further improved for carrying out policy simulations. The model can also be linked with the AGLINK system to assess alternative scenarios, taking into account the impact of India's commodity prospects on the international commodity markets, and vice versa. NCAER has continued to utilise the results from its in-house econometric model on the food commodity sectors to obtain medium term projections in the semi-annual outlook reports.

Dr. Merritt Cluff, former Senior Economist at FAO, visited India in January, 2014, to explore the possibility of drafting a thematic chapter on Indian agriculture for the OECD-FAO Agricultural Outlook Report 2014-23. Subsequently, a member of the study team and another expert from the Ministry of Agriculture visited OECD, Paris, in March 2014 to work with the outlook team to prepare this thematic chapter. Apart from an analysis on the agricultural situation in India, the chapter also generated medium-term projections and scenarios using the COSIMO model. A senior official from the Ministry of Agriculture was invited to attend the meeting of the Working Party on Agriculture Policy and Markets at OECD, Paris, in May 2014, where the thematic chapter was discussed and declassified. India's Alternate Permanent Representative participated at the release of the report by DG-FAO and SG-OECD in July 2014. Dr. Shesadri Banerjee, NCAER, visited FAO in 2015 for 4 weeks to become familiar with the operation of the COSIMO model.

III.2.1 AGLINK – COSIMO Framework:

COSIMO is an FAO project undertaken jointly with OECD that builds on OECD's Aglink model, and unites various databases, economic modelling activities and expert judgments to enhance our analytical capacity to look at markets, policies and emerging issues. COSIMO is a partial-equilibrium world agricultural model, currently encompassing about 48 countries and regions and 18 commodities. The goal of AGLINK-COSIMO model, primarily, is to provide 'consensus analyses' on the future evolution of international commodity markets and to encourage policy debates. Using the AGLINK-COSIMO model, an integrated system can be developed to link up short, medium and long term projections. Subsequently, various scenarios can be generated to analyse emerging market and policy issues. (OECD/Food and Agriculture Organization of the United Nations (2014), OECD-FAO Agricultural Outlook 2014, OECD Publishing. http://dx.doi.org/10.1787/agr_outlook-2014-en)

The model provides explicit specification of the supply-demand equilibrium and the interactions between domestic and international markets. Based on clearly defined assumptions, the model produces a measurement that can serve as the basis of comparison or the 'baseline', and enables forming expectations for the future. Such an equilibrium consistency framework is suitable for medium term projections for India.

III.2.2 Stand-alone India COSIMO Model

The stand-alone India COSIMO model is a partial equilibrium model for the main agricultural commodities. Non-agricultural markets are not modelled and are treated as exogenous to the model. The model is featured by elasticities, technical parameters and policy variables. It is nested on the behaviour of cost minimisation (or profit maximisation; as they are dual problem) on the production side and utility maximisation (given budget constraint) on the consumption side. It provides representations of national and global agricultural markets where all the major agricultural sectors are assumed to be connected. The outlook simulation tool that constructs projections over a ten-year period characterises the final equilibrium of the crop and livestock sectors. (OECD/Food and Agriculture Organization of the United Nations (2014), OECD-FAO Agricultural Outlook 2014, OECD Publishing. http://dx.doi.org/10.1787/agr_outlook-2014-en)

III.2.3 Building Blocks of the Model: The key assumptions of the model are as follows

1. First, the world markets for agricultural commodities are competitive.
2. Second, buyers and sellers view domestically produced and traded commodities to be perfect substitutes.

Table III.9: The List of Commodities Covered in the COSIMO Model

List of Commodities		
Wheat	Beef	Skim Milk Powder
Coarse Grains	Sheep meat	Whole Milk Powder
Rice	Pig meat	Cheese
Oilseeds	Poultry	Butter
Vegetable Oils	Eggs	Fresh Dairy Products
Oilseed meals	Cotton	Bio-fuels
Roots and Tubers	Sugar	

The behavioural structure of the India COSIMO Model is premised on the simple supply-demand interaction and price determination process. The functional relationships among the variables and a brief explanation on the parameters, solution procedures and exogenous variables are given in **Appendix 2**. The model, its parameters, data and solution procedures have been developed in collaboration with FAO.

III.2.4 Alternative Scenario Analyses

The projections provided by the India COSIMO model are subject to various types of uncertainties related to the macro-economy, technological advances (e.g., yields, bio-fuel), energy prices, weather-related production shocks, disease outbreaks, and agricultural policy developments. Therefore, scenario analysis is imperative to check the robustness of the observations and assess the policy implications. The India stand-alone COSIMO model is capable of simulating scenarios involving policies (production, consumption, and trade), socio- economic factors (macro-economic drivers, population), and technology (yields and costs).

III.2.5 Baseline Scenario for Indian Agriculture: 2015-16 to 2024-25

The base-line estimates obtained from the model for wheat, rice wheat, coarse grains, oilseeds, root tubers, sugar, vegetable oils, egg, milk and poultry are presented in **Tables III.10 to III.20.** The results that correspond to the major endogenous variables, viz., area, yield, production, food and feed consumption, stocks, and exports and imports are presented for the years 2014-15, 2015-16, 2020-21 and 2024-25. Exogenous variables are given in the **Appendix 3**.

Wheat: The area under wheat is projected to increase marginally from the base-year level of 31.50 million hectare (mha) to 31.82 mha by the year 2024-25. This implies that the scope of area increase in wheat is limited and the production increase should come mainly from improvement in yield in future. The projections indicate that the wheat yield in the country will increase modestly from the base year value of 3.04 tonnes/hectare (t/ha) to 3.58 t/ha. Consequently, the production of wheat will increase by around 18 million metric tonnes (mmt) during the period, 2014-15 to 2024-25. The demand for wheat is slated to increase due to increase in population and changes in dietary habits. Total food demand for wheat is projected to grow from 87.1 mmt in 2014-15 to 106.0 mmt by 2024, the rate being slightly higher than the growth in production.

Rice: In the case of rice, projections from the model indicate a marginal decrease in area from 43.5 mha in the base-year to 43.1 mha by 2024-25 (**Table III.11**). Yield gains in rice would be modest from 2.38 mt/ha to 2.81 mt/ha during this period. Total rice production is projected to rise from 103.7 mmt to 121.5 mmt. This implies that the scope of area increase in rice is limited and production increase will come mainly from improvements in yields in future. The total food demand for rice will increase from the base year value of 98.75 mmt to 116.4 mt by the year 2024-25. With sufficient balance of production over demand, the net trade in rice would remain positive.

Total food demand for wheat is projected to grow from 87.1 mmt in 2014-15 to 106.0 mmt by 2024, the rate being slightly higher than the growth in production.

The total food demand for rice will increase from the base year value of 98.75 mmt to 116.4 mt by the year 2024-25.

Table III.10: Supply and Demand Balance for Wheat (tmt)

Variables	Actual	Projected Figures			Actual growth rate from 2004-5 to 2014-15	Growth rate from 2015-16 to 2024-25
	2014	2015	2020	2024		
Area harvested (tha)	31500	32231	31921	31816	1.65%	-0.16%
Yield (mt/ha)	3.04	3.18	3.38	3.58	1.90%	1.39%
Beginning Stock	22018	26838	33701	34757		
Production	95910	102556	107965	114048	3.55%	1.23%
Imports	10	9	10	9	-38.70%	0.87%
Total Supply	**117938**	**129403**	**141676**	**148814**		
Feed Consumption	1996	2125	2529	2852	10.02%	3.23%
Food Consumption	77452	80041	88541	93219	1.64%	1.69%
Other use	7486	8063	8811	9413	2.30%	1.65%
Total Consumption	87100	90368	99950	105534	1.83%	1.71%
Exports	4000	7008	7733	8154	42.78%	-0.64%
Ending Stocks	26838	32027	33992	35127	9.61%	0.84%
Total Demand	**117938**	**129403**	**141676**	**148814**		

Note: tmt – thousand metric tonnes; tha - thousand hectares; mt/ha – metric tonnes per hectare

Table III.11: Supply and Demand Balance for Rice (tmt)

Variables	Actual	Projected Figures			Actual growth rate from 2004-05 to 2014-15	Growth rate from 2015-16 to 2024-25
	2014	2015	2020	2024		
Area harvested (tha)	43500	43247	43168	43146	0.08%	0.00%
Yield (mt/ha)	2.38	2.47	2.66	2.81	1.92%	1.47%
Beginning Stock	23500	20000	22184	23614		
Production	103650	106920	114659	121454	2.00%	1.47%
Imports	100	83	34	32	7.23%	-7.85%
Total Supply	127250	127003	136878	145100		
Feed Consumption	120	123	144	163	-12.97%	3.13%
Food Consumption	94130	95793	105136	110921	1.37%	1.65%
Other use	4500	4650	4985	5341	12.67%	1.53%
Exports	8500	5503	4067	4708	9.77%	-2.01%
Total Consumption	98750	100567	110265	116424	1.67%	1.65%
Ending Stocks	20000	20933	22546	23968	7.80%	1.53%
Total Demand	127250	127003	136878	145100		

Note: tmt – thousand metric tonnes; tha - thousand hectares; mt/ha – metric tonnes per hectare

Coarse Grains: The yield of coarse grains will increase from 1.34 mt/ha to 1.72 mt/ha during the period 2014-15 to 2024-25. Since there is no growth in area, yield gains will result in an increase in production from 37.4 mmt to 47.9 mmt during the period under projection. On the demand side, projections have shown that use of coarse grains both as food and feed will increase considerably. While the food demand would increase

from 34.9 mmt to 42.3 mmt, the feed demand would rise more or less at the same rate from 6.0 mmt to 8.0 mmt during the projection period.

Oilseeds: In case of oilseeds, projections from the model indicate a marginal decrease in area from 23.7 mha in the base year to 22.6 mha by 2024-25 (**Table III.13**). Yield gains in oilseeds would be modest from 0.92 mt/ha to 1.14 mt/ha during this period. Total oilseeds production is projected to rise from 21.8 mmt to 25.9 mmt. This implies that the scope for an increase in area under oilseeds is limited and the production increase will come mainly from an improvement in yield in future. The total food demand for oilseeds would increase from the base year value of 22.3 mmt to 26.0 mmt by the year 2024-25.

Total oilseeds production is projected to rise from 21.8 mmt to 25.9 mmt.

Table III.12: Supply and Demand Balance for Coarse Grains (tmt)

Variables	Actual	Projected Figures			Actual growth rate from 2004-5 to 2014-15	Growth rate from2015-16 to 2024-25
	2014	2015	2020	2024		
Area harvested (tha)	27840	27781	27853	27870	0	0.06%
Yield (mt/ha)	1.34	1.51	1.62	1.72	2.18%	1.46%
Beginning Stock	6635	5848	7141	7727		
Production	37360	42047	45186	47944	2.09%	1.52%
Imports	4	4	4	4	-15.13%	0.01%
Total Supply	**43998**	**47899**	**52331**	**55675**		
Feed Consumption	5966	6163	7235	8140	4.66%	3.14%
Food Consumption	24305	24821	27269	28707	0.04%	1.64%
Other use	4440	4640	4980	5314	1.59%	1.52%
Total Consumption	34945	35845	39654	42308	0.92%	1.87%
Exports	3205	5312	5368	5513	17.61%	-0.18%
Ending Stocks	5848	6743	7308	7855	13.77%	1.74%
Total Demand	**43998**	**47899**	**52331**	**55675**		

Note: tmt – thousand metric tonnes; tha - thousand hectares; mt/ha – metric tonnes per hectare

Table III.13: Supply and Demand Balance for Oilseeds (tmt)

Variables	Actual	Projected Figures			Actual growth rate from 2004-05 to 2014-15	Growth rate from 2015-16 to 2024-25
	2014	2015	2020	2024		
Area harvested (tha)	23660	22844	22501	22644	0.62%	-0.03%
Yield (mt/ha)	0.92	1.00	1.08	1.14	0.36%	1.50%
Beginning Stock	1500	730	829	895		
Production	21759	22877	24221	25888	0.98%	1.47%
Imports	271	271	295	315	35.78%	1.53%
Total Supply	**23530**	**23878**	**25344**	**27098**		
Food Consumption	3103	3241	3821	4355	4.30%	3.29%
Other use	223	232	247	262	0.93%	1.36%
Crushed	19022	19148	20162	21388	0.43%	1.31%
Total Consumption	22349	22621	24229	26004	0.93%	1.62%
Export	451	450	271	181	7.74%	-9.99%
Ending Stocks	730	807	844	912	-2.05%	1.48%
Total Demand	**23530**	**23878**	**25344**	**27098**		

Note: tmt – thousand metric tonnes; tha - thousand hectares; mt/ha – metric tonnes per hectare

The model projects sugar production to grow at 2.37 per cent to around 35 mmt in 2024 from 26.3 mmt in 2014.

Root Tubers: The area under root tubers is projected to remain the same as in the base year. This implies that the scope for an increase is limited and the production increase should come mainly from improvement in yield in future. The projections indicate that yield in the country would increase marginally from the base year value of 5.18 mt/ha to 5.85 mt/ha. Consequently, production will increase by around 1.5 mmt during the period 2014-15 to 2024-25. The demand will increase due to an increase in population and changes in dietary habits. Total food demand is projected to grow from 12 mmt in 2014-15 to 14 mmt by 2024.

Sugar: The model projects sugar production to grow at 2.37 per cent to around 35 mmt in 2024 from 26.3 mmt in 2014. India's sugar consumption is projected to increase at an annual rate of 2.28 per cent to 31.6 mmt from 25.5 mmt in 2014. On the trade front, India will remain a net exporter of sugar in some years and a net importer in others. Sugar stocks will decline by around 0.11 per cent in a zigzag manner to reach 14.1 mmt by 2024.

Table III.14: Supply and Demand Balance for Root Tubers (tmt)

Variables	Actual	Projected Figures			Actual growth rate from 2004-5 to 2014-15	Growth rate from 2015-16 to 2024-25
	2014	2015	2020	2024		
Area harvested (tha)	2337	2333	2328	2328	2.27%	-0.03%
Yield (mt/ha)	5.18	5.14	5.52	5.85	2.29%	1.45%
Production	12093	11983	12844	13611	4.55%	1.42%
Import	8	298	623	534	0.58%	5.15%
Total Supply	**12101**	**12281**	**13468**	**14145**		
Feed Consumption	0	0	0	0	-0.27%	3.21%
Food Consumption	11466	11659	12914	13632	4.26%	1.71%
Other use	1	1	1	2	6.48%	1.63%
Total Consumption	12048	12228	13417	14097	4.53%	1.55%
Exports	53	53	50	48	10.82%	-1.03%
Total Demand	**12101**	**12281**	**13468**	**14145**		

Note: tmt – thousand metric tonnes; tha - thousand hectares; mt/ha – metric tonnes per hectare

Table III.15: Supply and Demand Balance for Sugar (tmt)

Variables	Actual	Projected Figures			Actual growth rate from 2004-5 to 2014-15	Growth rate from 2015-16 to 2024-25
	2014	2015	2020	2024		
Beginning Stock	12138	12138	12777	13701		
Production	26300	28091	31353	34642	3.80%	2.37%
Imports	525	503	334	267	14.13%	-2.34%
Total Supply	38963	40732	44463	48609		
Food Consumption	25525	25630	29317	31625	2.40%	2.28%
Total Consumption	25525	25630	29317	31625	2.40%	2.28%
Exports	1300	1101	2264	2977	14.95%	5.64%
Ending Stock	12138	14001	12882	14007	5.17%	-0.11%
Total Demand	38963	40732	44463	48609		
Sugarcane						
Area harvested (tha)	5087.18	5002.13	4985.05	4991.66	2.62%	-0.02%
Production	342223.22	356636.01	382517.80	406192.67	3.51%	1.42%
Yield (t/ha)	67.27	71.30	76.73	81.37	0.89%	1.44%

Note: tmt – thousand metric tonnes; tha - thousand hectares; mt/ha – metric tonnes per hectare

Vegetable oils: The model projects India's vegetable oil production at 8.7 million tonnes by 2024, increasing at an annual rate of 1.37 per cent. Due to an increase in per capita income and changes in diet pattern, vegetable oil consumption is projected to increase annually at a rate of 3.91 per cent. A widening of the supply demand gap will lead to 5.07 per cent annual increase in total vegetable oil imports. Total vegetable oil stocks will increase by 4.04 per cent to 2 million tonnes by 2024, which is faster than the vegetable oil production growth rate.

The model projects India's vegetable oil production at 8.7 million by 2024, increasing at an annual rate of 1.37 per cent.

Table III.16: Supply and Demand Balance for Vegetable Oils (tmt)

Variables	Actual	Projected Figures			Actual growth rate from 2004-5 to 2014-15	Growth rate from 2015-16 to 2024-25
	2014	2015	2020	2024		
Beginning Stock	1830	1660	2249	2656		
Production	7672	7730	8211	8707	0.94%	1.37%
Imports	12207	13778	17940	21512	9.29%	5.07%
Total Supply	**21709**	**23168**	**28400**	**32876**		
Food Consumption	19614	20810	25534	29486	5.45%	3.91%
Other use	200	208	220	233	5.50%	1.30%
Total Consumption	19955	21156	25981	30049	5.50%	3.95%
Exports	94	90	82	77	-2.10%	-1.82%
Ending Stock	1660	1922	2336	2750	5.72%	4.04%
Total Demand	**21709**	**23168**	**28400**	**32876**		

Egg: The model projects egg production at 6.1 million tonnes by 2024, implying an annual production growth rate of 4.0 per cent. Due to increase in per capita income and changes in diet pattern, egg consumption is projected to increase annually at 4.07 per cent, which is equal to the production growth rate.

Table III.17: Supply and Demand Balance for Egg (tmt)

Variables	Actual	Projected Figures			Actual growth rate from 2004-5 to 2014-15	Growth rate from 2015-16 to 2024-25
	2014	2015	2020	2024		
Production	3972	4255	5306	6141	4.62%	3.99%
Food Consumption	3870	4154	5205	6040	4.73%	4.07%
Total Consumption	3870	4154	5205	6040	4.73%	4.07%

Milk: The projections indicate that the annual yield would increase marginally from the base year value of 1.13 mt/cow to 1.35 mt/cow. Consequently, production will increase by around 50.6 mmt during the period 2014-15 to 2024-25.

Table III.18: Supply and Demand Balance for Milk (tmt)

Variables	Actual	Projected Figures			Actual growth rate from 2004-5 to 2014-15	Growth rate from 2015-16 to 2024-25
	2014	2015	2020	2024		
Cow inventory	120385	120890	131091	139164	2.24%	1.62%
Yield	1.13	1.14	1.26	1.35	1.65%	1.75%
Production	136599	138316	165005	187194	3.89%	3.37%

Poultry: The model projects that production and consumption will increase at the same rate of 2.44 per cent.

Table III.19: Supply and Demand Balance for Poultry (tmt)

Variables	Actual	Projected Figures			Actual growth rate from 2004-5 to 2014-15	Growth rate from 2015-16 to 2024-25
	2014	2015	2020	2024		
Live Inventory	985123	1034004	1187946	1294377	7.13%	2.44%
Beginning Stock	0	0	0	0		
Production	2651	2782	3196	3483	6.59%	2.44%
Imports	0	0	0	1	12.35%	17.58%
Total Supply	**2651**	**2782**	**3197**	**3483**		
Food Consumption	2643	2776	3196	3483	6.57%	2.46%
Total Consumption	2643	2776	3196	3483	6.57%	2.46%
Exports	7	6	1	0	18.09%	-39.58%
Ending Stocks	0	0	0	0	0.00%	1.70%
Total Demand	**2651**	**2782**	**3197**	**3483**		

Prices: According to the model's projections, prices are projected to increase annually at more than 5 per cent for all commodities except for the export prices for sugar and poultry and producer prices for sugar and sugarcane.

Table III.20: Prices of Food Commodities

Rs/mt

Variables	Actual	Projected Figures			Actual growth rate from 2004-5 to 2014-15	Growth rate from 2015-16 to 2024-25
	2014	2015	2020	2024		
Rice						
Export price	27336	24909	31601	37989	10.72%	4.66%
Producer price	27519	26682	35344	41611	9.08%	4.94%
Consumer price	36218	37318	49290	60458	8.44%	5.34%
MSP	13600	14243	17701	21163	10.24%	4.40%
Wheat						
Export price	18242	15580	19011	22880	9.39%	4.29%
Producer price	17558	13841	16654	19891	8.02%	4.38%
Consumer price	22272	21776	27997	34597	8.37%	5.22%
MSP	14500	13479	16303	19576	8.60%	4.33%
Coarse Grains						
Export price	11290	11128	14677	17699	11.34%	5.01%
Producer price	16797	15404	20285	24370	10.22%	5.03%
Consumer price	21337	21757	28683	35502	10.56%	5.40%
Oilseeds						
Export price	27459	26263	33023	39824	9.61%	4.69%
Producer price	34345	32866	44579	55667	9.03%	5.80%
Root Tubers						
Producer price	12392	12627	15113	17875	14.33%	4.46%
Consumer price	24260	25327	32079	39222	10.06%	5.09%

Sugar						
Export price	20590	22769	27307	32878	9.49%	3.72%
Producer price	36061	23315	25149	29074	8.36%	2.88%
Consumer price	37473	81575	99588	120268	8.72%	4.46%
Sugarcane						
Producer price	1979	2243	2534	3030	9.81%	3.74%
Vegetable Oils						
Export price	49550.68	45609	61798	74525	8.05%	5.37%
Producer price	74988.25	70227	98810	122293	4.90%	6.09%
Consumer price	99866.01	100865	136515	170132	6.86%	5.76%
Egg						
Producer price	102735	98840	121611	150131	11.34%	4.95%
Consumer price	134115	132731	166584	206479	10.10%	5.12%
Milk						
Producer price	34998	33166	51658	68759	9.69%	7.81%
Poultry						
Export price	118807	118326	110875	133710	13.86%	2.42%
Producer price	95455	91425	138690	203100	6.64%	9.29%
Consumer price	150782	152084	215117	291279	9.86%	7.42%

III.3 Results based on the Econometric Model

In collaboration with ISEC, we have applied an econometric model of production, exports and prices for major food commodities to obtain projections at the national level. Annual national level data on a range of factors influencing supply and demand has been used in estimating this model. The model was initially developed at NCAER to assess the supply-demand balance for food commodities. A brief description of the model is provided in **Appendix 3.** The key relationships captured in the model are the following.

- Production is estimated using either crop area and yield equations or production equations – the choice being determined by the statistical properties of the estimated equations. The factors influencing production are the lagged area under the crop, lagged price of the crop relative to the price of other commodities competing with it for land and other inputs, irrigated area, and prices of fertilisers relative to crop price. When area and yield equations are estimated, the independent variables are selected in a logical manner.
- Net exports are modelled as a function of world income, export prices, domestic production, domestic prices and the exchange rate.
- Domestic price is estimated as a function of domestic production, MSP, export price and own lagged value.

Based on a set of assumptions relating to exogenous variables, the estimated set of equations have been used to project the values of production, net exports and prices in the case of rice, wheat, coarse cereals, pulses and oilseeds. These do not cover the entire set of food commodities considered in the study. The remaining commodities will be taken up for model based assessment in forthcoming reports.

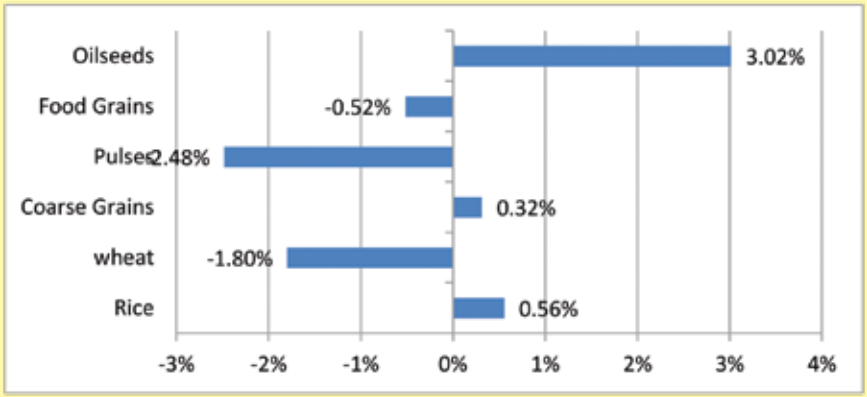
The projection based on the econometric model is presented in **Table III. 21**. As in case of COSIMO model, the econometric model also indicates that the scope for an increase in area is limited in the case of all crops except oilseeds. The production growth rates estimated from the econometric model are based on the projected pattern of the prices of crops and other exogenous variables. The model also provides estimates of post-harvest prices of food grains and oilseeds and exports of food grains, pulses and oilseeds.

The prices of rice and coarse grain are projected to increase annually by 5.13 and 5.16 per cent, respectively well below the actual increase of 8.29 and 8.98 per cent per year during the period from 2004-2014. Wheat prices are projected to increase by 0.17 per cent and oilseeds prices by 6.57 per cent per year. Oilseeds prices are projected to increase at a higher rate than that of rice and wheat.

Table III.21: Econometric Models Results

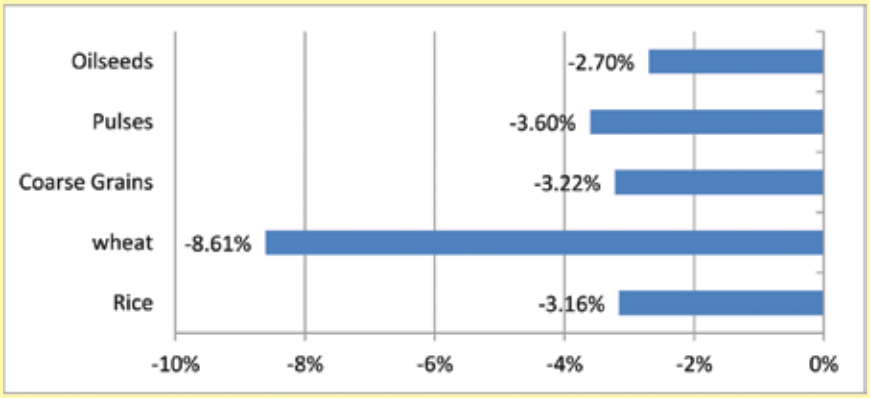
Variables	Actual Figures	Projected figures		Actual growth rate	Growth rate
Area	2014-15	2020-2021	2023-24	2004-2014	2015-2023
Rice	43.69	47.13	48.11	0.10%	0.85%
Wheat	29.15	30.80	31.23	1.39%	0.56%
Coarse Grains	24.14	24.41	24.42	-1.82%	-0.16%
Pulses	23.17	23.85	23.85	0.81%	0.06%
Food Grains	120.15	126.19	127.60	0.11%	0.43%
Oilseeds	29.38	32.46	34.84	0.31%	2.50%
Production					
Rice	102.54	124.41	133.44	1.95%	2.51%
Wheat	90.78	101.18	105.91	3.43%	1.63%
Coarse Grains	40.42	43.90	47.71	2.31%	2.63%
Pulses	17.39	19.03	19.74	3.77%	1.29%
Food Grains	251.13	288.52	306.79	2.65%	2.14%
Oilseeds	27.38	45.64	52.72	1.91%	4.93%
Export					
Rice	11.98	11.52	14.23	10.00%	6.42%
Wheat	2.92	2.62	3.29	36.17%	7.95%
Coarse Grains	3.26	6.59	9.95	18.07%	10.52%
Pulses	0.02	0.00	0.00	-34.88%	-16.75%
Food Grains	18.17	20.73	27.46	12.37%	7.93%
Oilseeds	1.38	2.37	2.94	11.83%	7.19%
Farm Harvest Price (FHP)					
Rice	1234.56	1604.21	1871.17	8.29%	5.13%
Wheat	1469.77	1345.53	1352.43	8.78%	0.17%
Coarse Grains	1291.23	1758.05	2090.55	8.98%	5.76%
Pulses	3701.41	4968.30	5815.33	8.82%	5.22%
Oilseeds	3993.26	5312.75	6480.17	9.26%	6.57%

Figure III.1: Difference between Projected Growth Rates of Production (% Per Year) and Actual during 2004-05 to 2014-15



Note: Negative difference imply that actual was higher than projected production.

Figure III.2: Difference between Projected Growth Rates of FHP (% per year) and Actual during 2004-05 to 2014-15



Note: Negative difference imply that actual was higher than projected FHP.

III.4 Implications for India

Meeting the increasing demand for most agricultural commodities in India, driven by rising income levels, growing population, increasing urbanisation and increasing feed use will require a substantial expansion of production in coming decades. While cereals will continue to remain a key dietary component in India, rising protein consumption will require increased production of livestock and dairy products, which also implies greater demand for feed grain and oilseeds. In order to retain the comparative advantage India enjoys in exports of some commodities such as rice, wheat, maize, sugar, and oilseed meal and to minimise the increasing dependence on imports to meet the growing domestic consumption of pulses and vegetable oils would require a dramatic improvement in the production of these crops.

Yield increases should drive production growth of most crops. Although Indian crop yields for most commodities has shown an increasing trend in recent years, yields of most crops in India with the exception of wheat are still significantly below world averages and yields in many other countries in the region. Hence, continued investment in research and development, and extension services remain critical to achieve the much

Although Indian crop yields for most commodities has shown an increasing trend in recent years, yields of most crops in India with the exception of wheat are still significantly below world averages and yields in many other countries in the region.

needed productivity gains.

The rate of production growth is constrained by various factors such as limited scope for expansion of agricultural land, soil degradation, particularly in the wheat-rice belt of northern India, and water scarcity. Furthermore, climate change is looming large with significant negative yield impact predicted in the medium-term. Agricultural land will continue to decline slowly over time, due to rapid urbanization and industrialization with India's cropping intensity already the highest in the world. Increasing cropping intensity, particularly the rice-wheat rotation in the Gangetic belt, unbalanced fertiliser use, over exploitation of ground water and reduced organic carbon in this region would further lead to soil degradation limiting yield potential in future.

India typically receives adequate water supply through monsoon rains but large temporal and spatial variations in rainfall limit water availability leading to drought in some regions and floods in others. Furthermore, irrigation water potential cannot be fully utilised due to topographical and other concerns such as inter-state water disputes, high losses to evaporation and evapo-transpiration. In this context, inter-linking large rivers of India, a dream that has been around for a while, should be taken up more seriously, although this would require a massive amount of political and financial capital. Improving agricultural productivity through innovation that improves water use efficiency is also as important as enhancing irrigation potential. However, lack of regulated use and power and irrigation subsidies at state level are major impediments. India is blessed with an abundant supply of solar energy, that too at a time when the crops are at critical growth stages. Solar energy driven pump sets is a viable alternative for electrical and diesel pumping systems in farm irrigation for farmers. It can drastically reduce farm electric and diesel costs, reducing production cost. The conversion of input and food grain subsidies into direct cash transfer should help plug subsidy leakages and ensure greater availability of funds for strategic public investment in areas such as irrigation, building of grain storage systems and cold chains.

Countries with dominant trade shares may be considrerd as price setters in the global market for various agricultural commodities and thus, their marginal cost of production plays an important role in the future course of global prices. India should strive to reduce the marginal cost of traditional export items such as rice (both coarse and basmati), wheat, maize, oilseeds and sugar to maintain its competitive edge in the world market. The connection between the domestic Indian and the international market is often weak due to policies such as market support price, state intervention, export restrictions and tariff. Indian domestic commodity markets should get more and more integrated with global markets to take advantage of global market signals to guide farmers in crop selection.

Indian per capita wheat consumption is projected to reach the global level in the next decade. The implementation of NFSA will further contribute to increase in domestic consumption.

The following is a commodity by commodity analysis of how the medium term global outlook presented by various agencies, particularly OECD-FAO, will affect India's trade outlook for major commodities.

Wheat: Increasing domestic consumption of wheat in India will reduce exportable surplus despite expected higher production growth. Indian per capita wheat consumption is projected to reach the global level in the next decade. The implementation of NFSA will further contribute to increase in domestic consumption.

Despite an unstable production trend, the Russian Federation is expected to further

increase production, with Ukraine projected to lead the production growth. The United States and Canada are projected to be the major wheat exporters in 2023 followed by CIS countries, mainly the Russian Federation, Ukraine and Kazakhstan. Argentina is also expected to improve its share of international wheat markets. All these factors will make Indian wheat uncompetitive as Ukraine and Russian prices are typically lower than Indian FOB prices in US$ terms. However, because of its geographical proximity India has the potential to export wheat to neighbouring countries such as Bangladesh and Sri Lanka. While FAO-OECD projections indicate that India will be an exporter of wheat in the medium term, although the amounts exported will decline, FAPRI projects India as a small exporter with miniscule imports in 2016. IGC projects India to be a net importer, albeit small, of wheat from 2017. India should establish grades and standards comparable with international standards to facilitate exports. There is also need to focus on cultivating durum wheat, which has better export prospects, in states like Punjab where yields are high and marginal cost is low.

Rice: Global rice trade will contune to expand relatively quickly in the next ten years, but at a smaller rate than in the previous decade. However, Indian rice exports will face stiff competition in the global market, with Thailland projected to regain its leadership from India as the world's largest rice exporter. Thailand's rice pledging scheme, which was resumed in 2011, has accumulated large inventories and the manner in which they will eventually be released has important implications for global rice trade in general and Indian rice exports in particular. Furthermore, Vietnam, Cambodia and Myanmar are expected to become major rice exporters. The regular increase in the support price of paddy to compensate for the increasing cost of production could make Indian rice non-competitive globally. Furthermore, the government's frequent ban on non-basmati rice exports will make India an unreliable supplier of rice in the world market.

Indian rice exports will face stiff competition in the global market, with Thailland projected to regain its leadership from India as the world's largest rice exporter.

As Africa will continue to remain a major importer of rice as local producers are not expected to meet growing domestic demand despite government efforts, India should continue to focus on this market, where there is a preference for Indian, medium quality rice. Efforts should be made to resolve saniary and phytosanitary impediments with countries in this region such as Nigeria and Iran, which are traditionally large markets for Indian rice. Due to geographical proximity, Indian rice is likely to remain competitive in neighboring countries such as Sri Lanka and Bangalesh, which are rice importers in most years. India has a comparative advantage in basmati rice trade, which needs to be further exploited by incerasing the area under this variety and improving yields by introducing new higher yielding varities. There is also need to improve the milling quality of rice for it to remain competitive in the global market.

Pulses: Pulses, an important protein source in the largely vegetarian population in India, are not covered by global projections by any agencies. With likely increasing per capita consumption, total pulse consumption in India is expected to grow. India is now the world's largest importer of pulses with pulses ranking as the second largest agricultural commodity imported after vegetable oils in value terms. As the result of a widening demand supply gap, pulse imports are expected to grow further in coming years. As India is the largest producer of pulses in the world with the largest area under this crop, a modest increase in yield through better seed distribution and extension efforts to encourage practices such as growing pulses in the rice fallows, could make India self-sufficient in pulses and even an exporter. Otherwise, countries with dominant trade shares in pulses such as Myanmar and Canada will be the price setters and the

As India is the largest producer of pulses in the world with the largest area under this crop, a modest increase in yield through better seed distribution and extension efforts to encourage practices such as growing pulses in the rice fallows, could make India self-sufficient in pulses and even an exporter.

All agencies project Indian coarse grain production to increase at an annual compound growth well above the global total coarse grain growth rate, mostly driven by maize.

There is also potential to expand production and exports of other coarse grains such as ragi (finger millet), with the rising awareness of the nutritive benefits of these grains globally.

Globally, more than 60 per cent of all vegetable oil exports continue to originate from Indonesia and Malaysia with India remaining a major market.

Indian pulse market will continue to be influenced by production and marginal cost of production of pulses in these countries.

Coarse grains: All agencies project Indian coarse grain production to increase at an annual compound growth well above the global total coarse grain growth rate, mostly driven by maize. However, expanding poultry and dairy sectors will cause consumption to increase at a faster pace, reducing exportable surplus. OECD/FAO projections are highly optimistic about India's total coarse grain exports, mainly consisting of maize in the medium term; they predict that exports will increase at a rate of 5.2 per cent annually during the projection period to reach 5.6 mmt in 2023. However, other agencies, except IGC, are rather pessimistic about India's coarse grain exports with USDA projecting a negative annual growth rate of 5.3 per cent to touch 2.4 mmt in 2023 and FAPRI projecting an annual growth rate of -2.7 per cent with exports at 1.5 mmt tonnes in 2021. IGC projections are more optimistic with exports projected to reach 4.0 mmt tonnes of maize by 2019, implying a growth rate of 3.14 per cent per annum, significantly above the global maize trade growth rate of 0.19 per cent. Global maize trade is expected to be 153 mmt tonnes in 2019. However, much will depend on the trend in coarse grain yields in India in the future. There is already a large inter-state yield gap in maize with states such as Karnataka and Andhra Pradesh, where most of the area is covered under hybrid seeds, having much higher yields than states like Bihar, Rajasthan and Uttar Pradesh, where mostly traditional varieties are grown. If the yield gap could be bridged, India could emerge as a major exporter of maize, particularly to neighbouring countries such as Bangladesh and Sri Lanka.

There is also potential to expand production and exports of other coarse grains such as ragi (finger millet), with the rising awareness of the nutritive benefits of these grains globally. This coarse grain, described as a "smart crop", is making a slow but steady comeback, with International Research Institutes such as ICRISAT giving special focus on millets. These crops are also considered the life-line of small and marginal farmers in semi-arid areas. Besides being rich in nutrition, these crops consume less water. Indian export development organizations such as APEDA should try to promote these crops, largely grown in India, in other nutrient conscious countries in the West and Japan.

Oilseeds and Vegetable Oils: As in the case of most other crops, yield of oilseeds crops in India is low as compared to other countries although area coverage is much higher. As the crop is mostly grown in rain-fed areas, year-to-year fluctuations in yields is high, aggravating the demand-supply imbalance and significantly increasing imports in a poor monsoon year. Globally, more than 60 per cent of all vegetable oil exports continue to originate from Indonesia and Malaysia with India remaining a major market. The significant increase projected in palm oil production in these countries should benefit India. However, strong demand for food and fuel is expected to push the prices up, making imports costlier. The future of bio-fuel production and associated feed stock is hence greatly determined by how the main producers of bio-fuel will design their policies. Thus policy changes could completely change the production outlook for these commodities. Oil palm crop is also highly vulnerable to El Nino conditions. India, therefore, should try to diversify its vegetable oil import basket, sourcing soybean oil, and sunflower seed oil from countries like the USA, Argentina and Ukraine and Russian Federation. The price of oilseed meal is not projected to increase as much as vegetable oils, which will be disadvantageous to India, a major exporter of oil meals, particularly soybean meal. However, there is potential to export to neighbouring countries such as

Pakistan, Bangladesh, Sri Lanka, and the Middle East, where India has a comparative advantage due to geographical proximity.

Sugar: In the sugar market, Brazil is projected to remain the largest exporter with Thailand occupying second place. Australia is also projected to become a growing sugar exporting country. In real terms, world sugar prices are expected to follow a moderately upward trend, and will continue to follow the familiar "sugar cycle", mostly driven by specific market conditions in Asia and Brazil. The cost of production and the relative profitability of sugar and ethanol will determine the general level sugar prices, particularly in Brazil.

Because of the ever increasing cost of production of sugarcane in India, largely due to unrealistic farm support price fixation by states, the cost of production of sugar in India will continue to remain high unless the pricing policy for sugarcane is rationalised on the lines recommended by the Rangarajan Committee.[12] A major recommendation of the committee relates to revising the existing arrangement for price to be paid to sugarcane farmers, which suffers from problems of accumulation of payment arrears to sugar cane farmers in years of high price and low price for farmers in other years. Accordingly, the pricing formula should be based on linking the price of sugarcane to the revenue realised by sugar mills from sale of sugar and first stage by-products such as molasses. The existing price policy and regulation in the sugar sector in India has resulted in low sugarcane productivity, and stifled profitability and modernisation of sugar mills. Furthermore, to remain competitive and a reliable supplier of sugar in the global market, government should permit a freer international trade policy wherein quantitative controls and time restrictions on exports and imports should not be prescribed by the government.

Because of the ever increasing cost of production of sugarcane in India, largely due to unrealistic farm support price fixation by states, the cost of production of sugar in India will continue to remain high unless the pricing policy for sugarcane is rationalised.

[12]http://eac.gov.in/reports/rep_sugar1210.pdfrealized

CHAPTER IV

Changing Profile of Food Horticulture

IV.1 Background

Indian agriculture has achieved impressive growth in the last decade. There were significant achievements in all the sub-sectors, viz., agriculture, horticulture, dairying and fisheries. It has responded to ever increasing consumer demand and changing consumer preferences for food products. The performance of the horticulture sub-sector has been particularly impressive. Even during 2004-05 and 2009-10, when food production declined due to weak monsoon, there was increase in both the production and productivity of horticulture crops.

India is endowed with varied agro-climatic conditions, suitable for producing a wide range of fruits, vegetables, plantation crops and spices, which are together classified as horticulture crops. With the active policy support from the Government of India and its agencies like the National Horticulture Board (NHB), there has been a significant increase in the production and processing of horticultural crops during the last decade. India is now the second largest producer of fruits and vegetables in the world, with a production share of 14 per cent of global vegetables and 13.6 per cent of global fruit. It is the largest producer of mango and guava (45 per cent), papaya (43.7 per cent), banana (27.8 per cent), cauliflower (37.5 per cent) and okra (73 per cent). It is ranked 2nd in the production of onion (22.6 per cent) after China (26.3 per cent). India ranks first in the productivity of grapes (21.8 tonnes/hectare) and 2nd largest in the productivity of banana (37 tonnes/hectare) after China (41.6 tonnes/hectare).

Recent trends in horticulture production have highlighted some challenges that have arisen such as slowing down of yield increases in horticulture and inadequate processing facilities for fruits and vegetables. In this Chapter, an attempt has been made to analyse changing pattern of production, consumption and trade in horticulture crops in India. This chapter also examines the evolving food production and consumption pattern in India over the past two decades due to income induced diet diversification, impact of globalisation, increasing urbanisation and changing lifestyles. This will help draw some conclusion about the emerging food demand supply scenario and its policy implications.

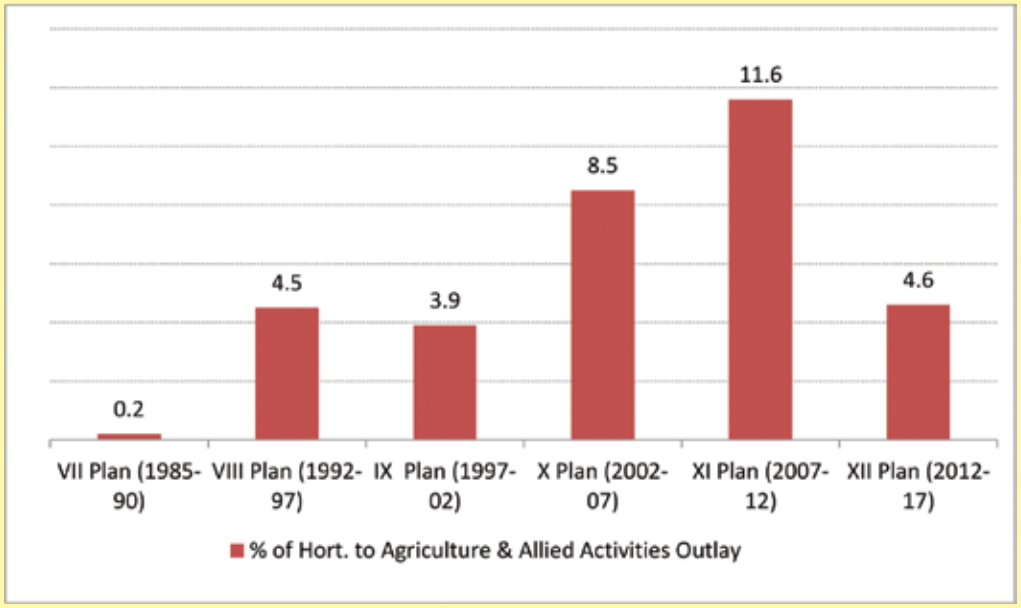
IV.2 Planning and Development

Realising the importance of the horticulture crops in providing better nutrition and better returns to farmers and as a diversification alternative for farmers, plan allocation for horticulture in the overall agricultural sector was raised substantially in various Five-year Plans of the government. In the ongoing Twelfth Five-Year Plan (2012-17), 4.6 per cent of the total outlay for the agricultural sector has been earmarked for horticulture (**Figure IV.1**)

Even during 2004-05 and 2009-10, when food production declined due to weak monsoon, there was increase in both the production and productivity of horticulture crops.

India is now the second largest producer of fruits and vegetables in the world, with a production share of 14 per cent of global vegetables and 13.6 per cent of global fruit.

Figure IV.1: Plan-wise Development Expenditure on Horticulture as share of Agriculture & Allied Activities Outlay (%)



Besides, there has been significant fund allocation for research in horticulture by the Indian Council of Agricultural Research (ICAR) in recent years.

Consequently, the area under horticulture crops increased from 12.8 million hectares in 1991-1992 to 16.5 million hectares in 2001-02 and further to 23.2 million hectares in 2011-12, registering an increase of 81 per cent during the past two decades.

The production of horticulture crops also increased from 96.6 million tonnes in 1991-1992 to 145.6 million tonnes in 2001-02 and further to 257.3 million tonnes in 2011-12, an increase of 166 per cent over two decades. Horticulture crops productivity has increased from 7.6 tonnes per hectare to 11.07 tonnes per hectare during the past two decades, an increase of 46 per cent.

IV.3 Trend in Area and Production of Horticulture Crops

It is seen from Table IV.1 and Figure IV.2 and IV.3 that the primary contributor to the growth in yield of horticultural crops is from yield increases in the case of fruits. Productivity of vegetables, plantation crops and spices and condiments has begun to stagnate, an issue that needs to be addressed.

Productivity of vegetables, plantation crops and spices and condiments has begun to stagnate, an issue that needs to be addressed.

Table IV.1: India - Area, Production and Productivity of Horticulture Crops

(A: Area in million ha; P: Production in million tonnes; Y: Yield in tonnes/ha.)

Year	Fruits			Vegetables			Flowers & Aromatic			Plantation Crops*			Spices & Condiments			Total		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1991-92	2.87	28.63	9.97	5.59	58.53	10.47	NA	NA	NA	2.30	7.5	3.26	2.01	1.90	0.95	12.77	96.56	7.56
2001-02	4.01	43.00	10.72	6.16	88.62	14.4	0.11	0.54	5.01	2.98	9.7	3.25	3.22	3.77	1.17	16.48	145.62	8.84
2011-12	6.71	76.42	11.40	8.99	156.3	17.39	0.76	2.22	2.92	3.58	16.4	4.57	3.21	5.95	1.85	23.24	257.28	11.07
2012-13	6.98	81.29	11.64	9.21	162.2	17.62	0.79	2.65	3.35	3.64	16.9	4.66	3.08	5.74	1.87	23.69	268.85	11.35
2013-14	7.22	88.98	12.32	9.40	162.9	17.33	0.75	3.19	4.25	3.68	16.3	4.43	3.16	5.91	1.87	24.20	277.28	11.46

*includes coconut, cashew nut, areca nut and cocoa.
Source: Horticulture Division, Dept. of Agriculture and Co-operation, M/o Agriculture, GOI.

Figure IV.2: Trend in Area and Production of Horticulture Crops

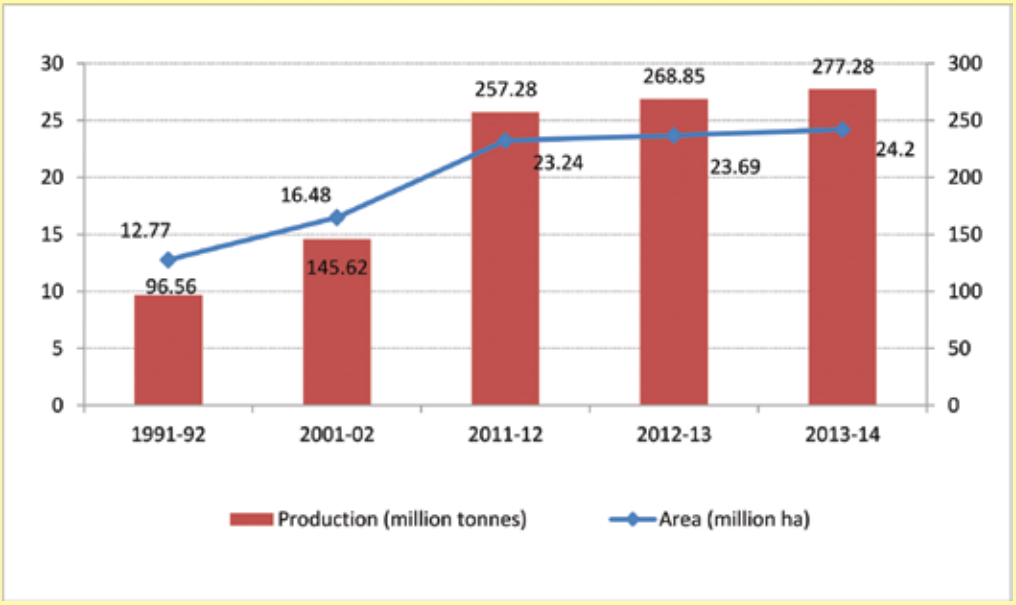
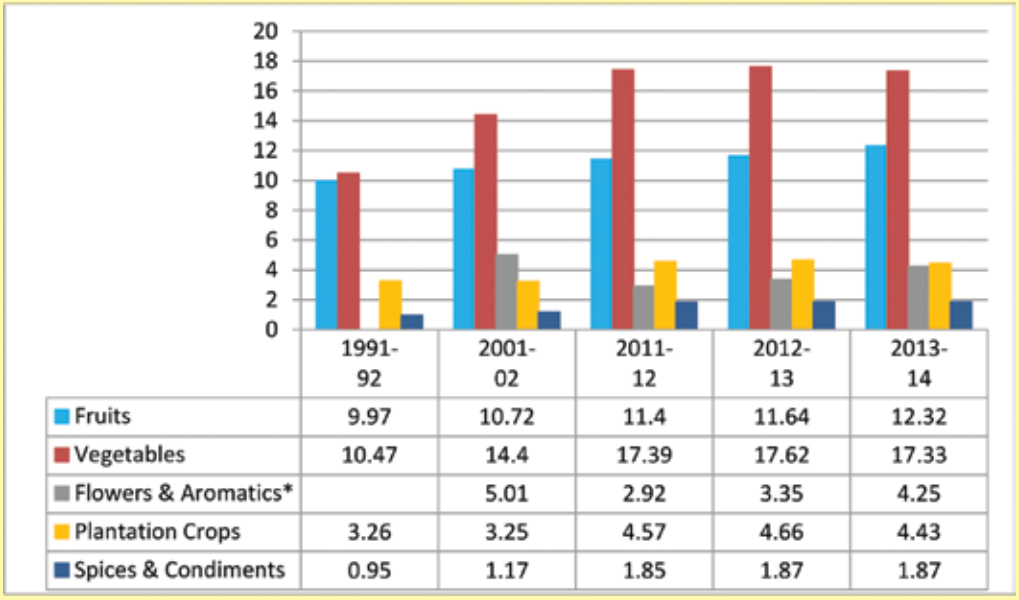


Figure IV.3: Yield Growth of Horticulture Crops during 1991-92 to 2013-14 (tonnes /ha.)



	1991-92	2001-02	2011-12	2012-13	2013-14
Fruits	9.97	10.72	11.4	11.64	12.32
Vegetables	10.47	14.4	17.39	17.62	17.33
Flowers & Aromatics*		5.01	2.92	3.35	4.25
Plantation Crops	3.26	3.25	4.57	4.66	4.43
Spices & Condiments	0.95	1.17	1.85	1.87	1.87

*Data for Flowers and Aromatic for 1991-92 is not available.

West Bengal, Uttar Pradesh, Maharashtra, Tamil Nadu, and Andhra Pradesh were the leading states in horticulture production in 2013-14, with a relative share of 9.6 per cent, 9.3 per cent, 8.8 per cent, 7.9 per cent and 7.6 per cent, respectively.

IV.4 Value of Output from Horticulture

Horticulture crops contribute more in value terms as compared to food grains. The value of output from all agricultural crops has gone up by 32.8 per cent since 2004-05 (at constant prices) whereas the value of output of horticulture crops has gone up

The value of output from all agricultural crops has gone up by 32.8 per cent since 2004-05 (at constant prices) whereas the value of output of horticulture crops has gone up by around 54 per cent during the same period.

by around 54 per cent during the same period. Table IV.3 shows the value of output from horticulture crops and from all agricultural crops during the period 2004-05 to 2012-13. It also shows the growth trend in the value of horticultural output. In value terms, the horticulture sub-sector contributed around 29.7 per cent of the total value of agriculture produce in 2004-05. This increased to 34.4 per cent in 2012-13 in constant prices (Figure IV.4).

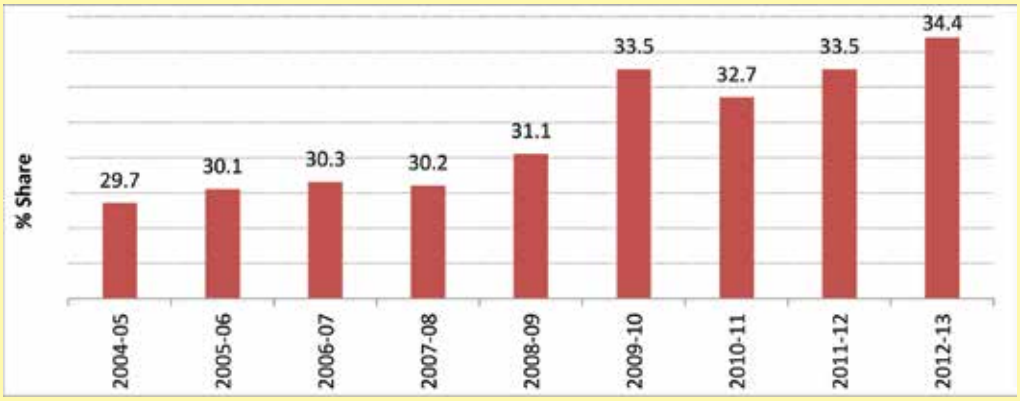
Table IV.2: Value of Output from Horticulture Crops vis-à-vis All Agriculture Crops

(At constant 2004-05 prices)(In Rs. '00 Crores)

Item/ Year	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	% GR in 2012-13 over 2004-05
All Agricultural crops	**4585**	**4846**	**5031**	**5326**	**5250**	**5241**	**5792**	**6094**	**6091**	**32.8**
Total Horticulture crops	**1363**	**1461**	**1523**	**1608**	**1632**	**1757**	**1896**	**2044**	**2095**	**53.7**
Total Fruits & Vegetables	1068	1148	1197	1266	1286	1381	1481	1557	1640	53.6
Total Condiments & Spices	132	139	141	157	154	170	184	224	202	53
Total Floriculture	50	57	66	65	70	75	85	119	106	112
Total Plantation Crops	113	117	119	120	122	131	146	144	147	30.1
% Share of Output from Horticulture to total Agricultural Output	**29.7**	**30.1**	**30.3**	**30.2**	**31.1**	**33.5**	**32.7**	**33.5**	**34.4**	

Figure IV.4: Share of Value of Output from Horticulture to total Agricultural Output (%)

(at constant prices)



Growing per capita income and changing lifestyles have led to increased demand for nutritious and high value foods, which were earlier out of reach of the common man, giving an impetus to the horticulture sector, particularly fruits. Fruits now constitute 32.1 per cent of total horticultural production in volume terms as against 29.6 per cent in 1991-92.

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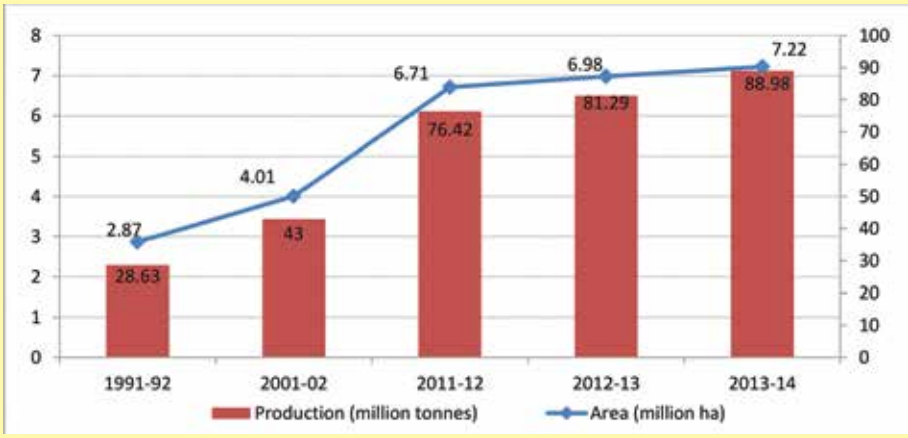
IV.5.1 Area and Production Trends in Fruits and Vegetables

Production of vegetables has gone up from 58.5 million tonnes in 1991-92 to 162.9 million tonnes in 2013-14. Fruits production has increased to 89 million tonnes from 28.6 million tonnes during the same period (Figure IV.5). Area planted to vegetables in 2013-14 was 9.4 million hectare while fruits occupied 7.2 million hectares (Figure IV.7). Productivity of vegetables has increased from 10.5 tonnes per hectare to 17.3 tonnes per hectare during 1991-92 to 2013-14 and of fruits from 10 tonnes per hectare to 12.3 tonnes per hectare during the same period. Banana, mango, citrus, papaya, guava and grapes account for a major share in total fruit production across India while potato, tomato, onion, brinjal, cabbage, cauliflower and tapioca account for a major share of vegetable production in the country.

There has been significant improvement in the productivity of vegetables since 1991-92. It has increased by 65 per cent since then but has stagnated at around 17.5 tonnes per hectare over the past three years. Fruit productivity has improved by 23.6 per cent during the same period, surpassing the world average of 11.4 tonnes per hectare. However, productivity of vegetables in India at 17.3 tonnes per hectare is below the world average of 19.6 tonnes per hectare.

Figure IV.5: Trend in Area and Production of Fruit Crops



Maharashtra, Andhra Pradesh, Gujarat, Tamil Nadu and Uttar Pradesh are the leading fruit producing states with a production share of 15.1 per cent, 11.8 per cent, 9 per cent, 8.3 per cent and 7.7 per cent respectively in 2013-14. They together account for over 50 per cent of the fruits produced in the country (Figure IV.6).

Figure IV.6: Share of States in Fruits Production (2013-14)

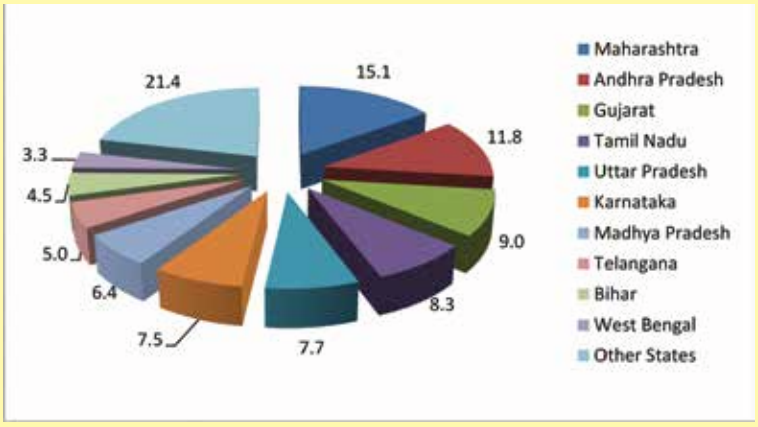
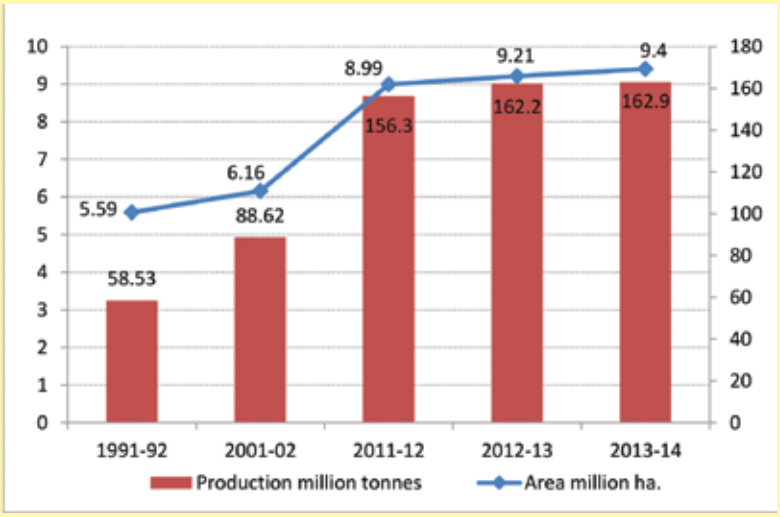


Figure IV.7: Trend in Area and Production of Vegetables



West Bengal, Uttar Pradesh, Bihar, Madhya Pradesh and Gujarat together accounted for 50 per cent of the total vegetable production in 2013-14 with a production share of 14.1, 11.4, 9.3, 8.0 and 7.1 per cent, respectively (Figure IV.8).

Figure IV.8: Share of States in Vegetables Production (2013-14)

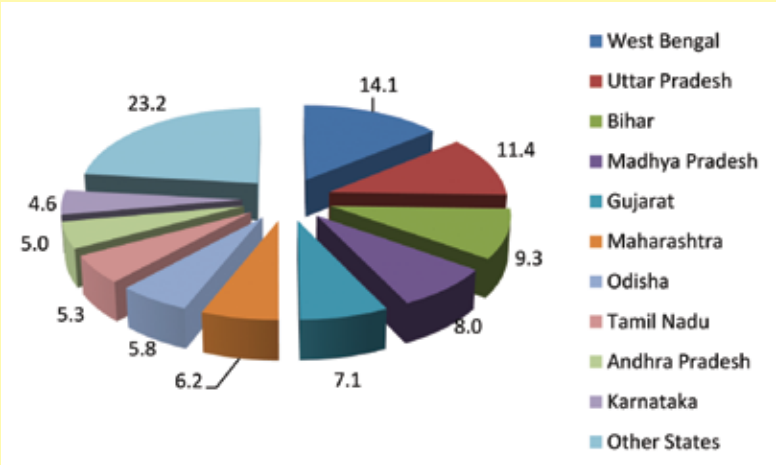
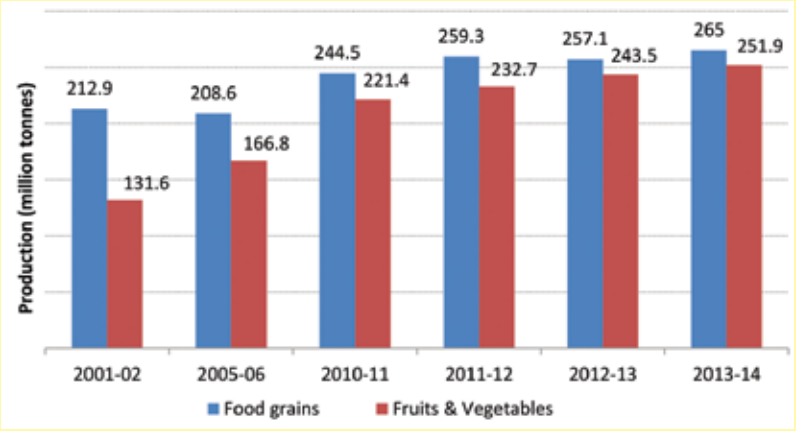


Figure IV.9: Production of Food grains vis-à-vis Fruits & Vegetables



The growth in the production of fruits and vegetables was higher than the growth in food grain production (Figure IV.9). Nevertheless, India still lags behind China, Brazil and Western countries in the productivity of fruits and vegetables. Hence, there is large scope for increasing fruit and vegetable production in India through yield improvements. The country has of late started working in this direction through various programmes and larger budgetary allocation for research and development.

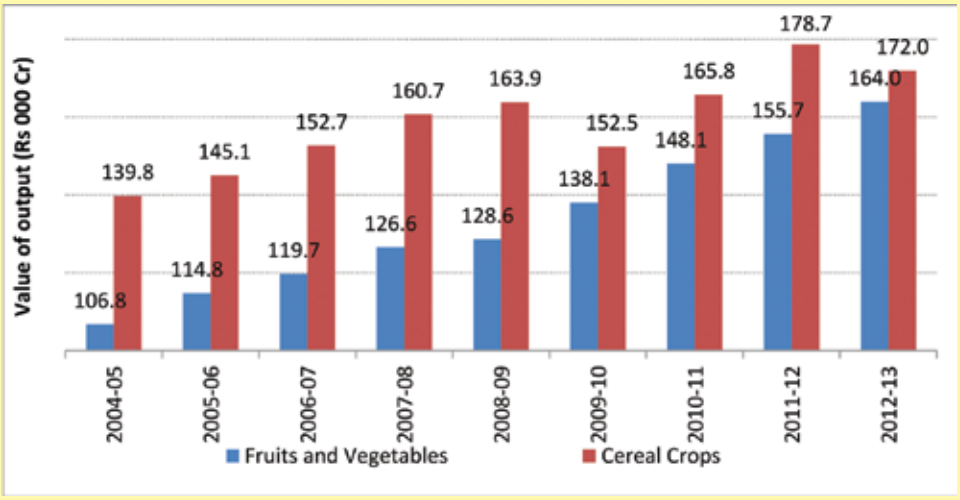
The output of horticulture crops has also shown significant improvement in value terms too over the years. During 2004-05, India produced fruits and vegetables valued at Rs. 1,06,800 crore as against Rs.1,39,800 crore worth of cereals. Table IV.3 and Figure IV.10 presents the value of output from selected horticulture crops and from selected cereal crops.

Table IV.3: Value of Output from selected Horticulture Crops and from selected Cereal Crops

(Rs. '00 Crore) (At constant 2004-05 prices)

Item/ Year	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Mango	142	152	163	163	162	181	191	205	225
Banana	85	98	112	119	124	133	121	137	129
Potato	88	92	85	107	85	127	131	117	128
Onion	36	40	46	49	41	41	59	59	57
Total Fruits & Vegetables	1068	1148	1197	1266	1286	1381	1481	1557	1640
Paddy	732	789	799	829	857	781	825	906	870
Wheat	478	472	539	552	562	557	592	649	630
Total Cereals including coarse cereals	1398	1451	1527	1607	1639	1525	1658	1787	1720
% value of Total Fruits & Vegetables to Total Cereals	76.4	79.1	78.4	78.8	78.5	90.6	89.3	87.1	95.3

Figure IV.10: Value of Output from Fruits and Vegetables and from Cereal Crops (000 Crore)



IV.5.2 Spices

There has been a significant increase in the production of spices over the last two decades. It has increased three-fold from 1.9 million tonnes in 1991-92 to 5.91 million tonnes in 2013-14 (Figure IV.11). Both area and productivity has contributed in the increase in spices production during the period. Productivity of spices has almost doubled since

1991. Gujarat (14.4 per cent), Andhra Pradesh (13.1 per cent), Rajasthan (11.4 per cent), Tamil Nadu (9.4 per cent) and Telangana (9.3 per cent) together contributed to over 57 per cent of total spices produced in the country in 2013-14 (Figure IV.12).

Figure IV.11: Trend in Area and Production of Spices & Condiments

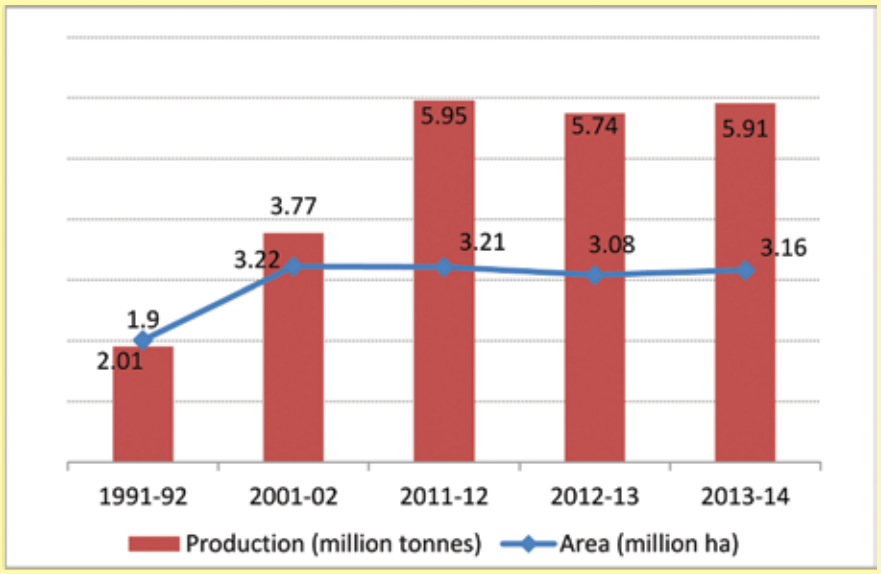
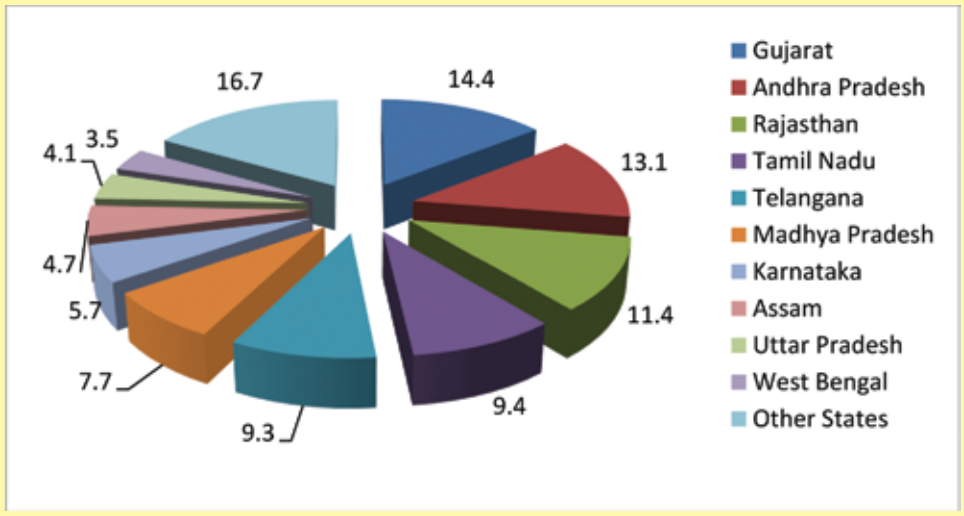


Figure IV.12: Share of States in Spices Production (2013-14)



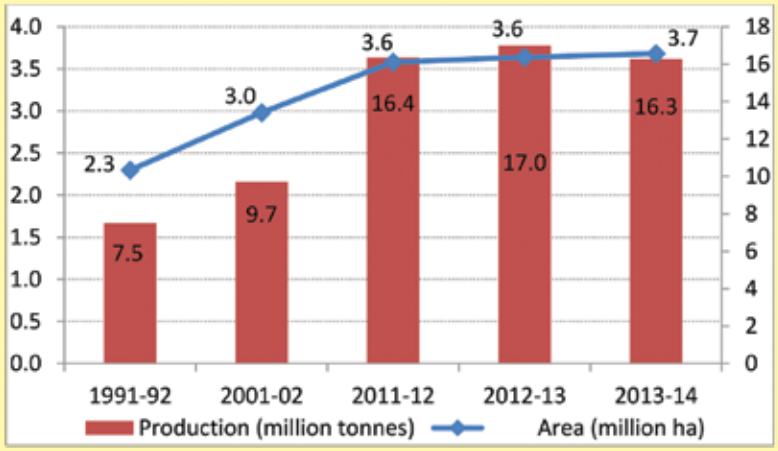
As regards future outlook for spices production, both area and yield of spices has stagnated, leading to stagnant production over the last few years. Since domestic demand as well as export demand is continuously growing, there should be increased emphasis on yield improvement through research and extension.

IV.5.3 Plantation Crops

Coconut is the major plantation crop in India accounting for 91per cent of the total production under plantation crops. Cashew nut, areca nut and cocoa are the other three important plantation crops. Area under plantation crops has increased from 2.3 million

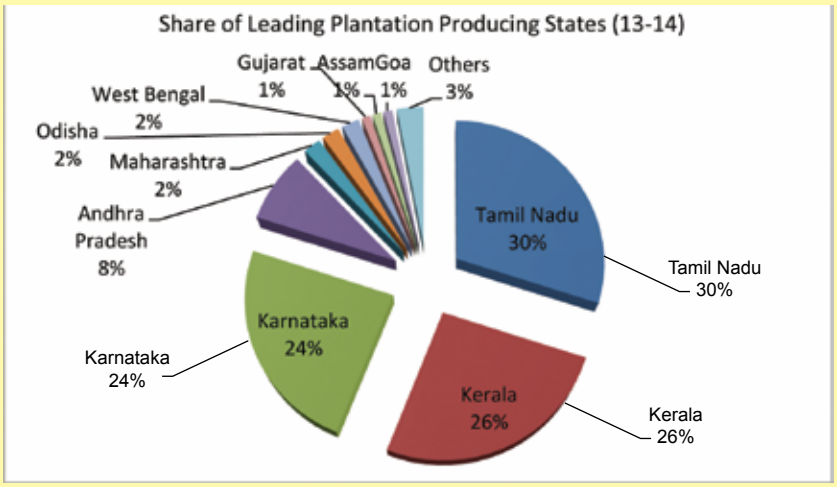
hectares to 3.7 million hectares since 1991-92 (Figure IV.13). However, production has more than doubled during the period because of the significant increase in both area and productivity by 61 per cent and 36 per cent, respectively since 1991-92. However, both area and yield have stagnated during the last few years resulting in production stagnation.

Figure IV.13: All India Area and Production of Plantation Crops



Tamil Nadu (30 per cent), Kerala (26 per cent) and Karnataka (24 per cent) together contributed to 80 per cent of total Plantation crops produced in the country in 2013-14 (**Figure IV.14**).

Figure IV.14: Production Share of Leading Plantation Producing States (2013-14)



IV.6 Returns from Horticulture

Studies conducted by agricultural universities and research institutions including Indian Institute of Horticultural Research, Bangalore, and Tamil Nadu Agricultural University reveal that farmers find it more viable and profitable to produce fruits, vegetables and other horticulture crops than cereals and pulses. Studies further revealed that an increasing number of farmers across size- class are opting to grow fruits and vegetables rather than food grains because of the significantly higher profit margins.

In a recent study in Haryana, the Agro-Economic Research Centre, Delhi found that returns from the cultivation of flowers, aonla (the Indian *gooseberry*), garlic, guava and

An increasing number of farmers across size- class are opting to grow fruits and vegetables rather than food grains because of the significantly higher profit margins.

kinnow are much higher than returns from cultivation of cereals and pulses (Table IV.4). However, returns from the cultivation of vegetables were found to be more profitable than from the cultivation of wheat but lower than that from the cultivation of rice.

Table IV.4: Net Returns from selected Horticulture and Other Crops (Rs. per Acre)

	Size of farm holding				
Crop	**Marginal**	**Small**	**Medium**	**Large**	**Total**
Kharif crops					
Paddy	0	12583	10852	12762	12499
Bajra	2750	4109	2649	3083	3063
Moong	0	0	14000	5303	5352
Flowers	19000	0	62500	0	40750
Vegetables	9665	14267	8972	6631	7476
Cotton	0	15231	13288	14419	14383
Sugarcane	0	0	0	17250	17250
Rabi crops					
Wheat	7417	6455	7027	5377	5558
Gram	0	0	0	6263	6263
Mustard	6000	10075	7022	7068	7086
Vegetables	9250	23013	7141	7190	8011
Horticulture crops					
Garlic	36350	29744	43261	41345	40612
Aonla	0	0	10776	30545	29840
Guava	34286	22837	27190	16147	19699
Kinnow	0	16519	15367	14246	14327

Source: Tuteja 2011/03, Impact of the National Horticulture Mission (NHM) Scheme in Haryana.

IV.7 Harvest and Post-Harvest Losses

Horticulture crops, specifically fruits and vegetables, are more perishable than other crops due to high water content. Several studies have concluded that in India harvest and post-harvest losses in horticulture crops in general and fruits and vegetables in particular are very high and no significant progress has been made in reducing the losses during the last two decades. Up to 20 per cent of the produce is lost at the harvest stage and at various stages of handling (storage, packaging, transportation and marketing). A recent study on the post-harvest losses by Associated Chambers of Commerce and Industry of India (ASSOCHAM) has reported that about 30 per cent of fruits and vegetables produced in the country are rendered unfit for consumption and India's post-harvest losses of fruits and vegetables are valued at over Rs. 200,000 crore annually. The study has cited various reasons for these losses, such as improper handling, lack of cold storage facilities, packaging, transportation and food processing facilities. The study shows that West Bengal tops the list of states in post-harvest losses, followed by Gujarat, Bihar, Uttar Pradesh and Maharashtra.

The Central Institute of Post-Harvest Engineering and Technology (CIPHET), Ludhiana, in its 2010 study, reported that at the all-India level, harvest and post-harvest

losses for fruit crops vary from 6 to 18 per cent, for vegetable crops from 7 to13 per cent and for plantation crops and spices from 1 to 9 percent (Table IV.5). Among fruits, guava, mango and apple reported losses exceeding 12 per cent. Vegetable crops such as tomato, mushroom and green peas reported losses exceeding 10 per cent. Among plantation crops and spices, losses were high for areca nut, turmeric and coriander at over 7 percent. In addition, losses occur at the consumer level due to inadequate methods of preservation at home, inappropriate methods of peeling and cooking.

Table IV.5: India – Harvest and Post-Harvest Losses of Fruits and Vegetables

Crop	% loss
Vegetables	7 to 13
Fruits	6 to 18
Plantation Crops and Spices	1 to 9

A recent study by YES Bank showed that India stored only two per cent of its horticulture products in temperature-controlled conditions, while China stored 15 per cent and Europe and North America stored 85 per cent of their products in such conditions.

The magnitude of post-harvest losses in fruits and vegetables needs to be minimised by proper pre- and post-harvesting operations, transportation and cold storage facilities. This will also ensure quality and add value to the produce and also empower farmer to command better prices. It will enable farmers get higher returns and the consumer better quality and larger supply, in addition to generating more employment opportunities in the rural sector though larger investments in the food processing sector.

IV.8 Processing and Value Addition

Studies have shown that in India, about three-fourth of fruits and vegetables are consumed in fresh form, while wastage and losses account for about 20 per cent. Only about 2 per cent of vegetables and about 4 per cent of fruit are being processed in India in contrast to some of the developing countries like Brazil, Malaysia, Philippines and Thailand where 30 to 83 per cent of the total fruits and vegetables produced are processed (Table IV.6). In India, only mango, pineapple, citrus fruits, grapes, tomatoes, peas, potatoes, cucumber are being processed on a major scale. There is greater scope for processing of papaya, sapota, banana, guava, and some other fruits. Among vegetables, there is larger scope for processing of potato, cauliflower, carrot, bitter-gourd, onion and garlic.

Table IV.6: Level of Processing of Fruits & Vegetables in selected Countries

Country	Level of Processing
USA	65%
France	70 %
Brazil	70 %
Malaysia	83%
Philippines	78 %
Thailand	30%
India	2.1%

Source: Cygnus Report, Indian Food Processing Sector, 2006.

A recent study by YES Bank showed that India stored only two per cent of its horticulture products in temperature-controlled conditions, while China stored 15 per cent and Europe and North America stored 85 per cent of their products in such conditions.

India consumes less than 10 per cent of food across categories in the processed form compared to over 60 per cent in the U.S.

India is also at the bottom of the table when it comes to value addition. It is at less than 10 per cent as compared to over 25 per cent in China, 50 per cent in the Philippines and up to 200 per cent in the UK. Further, studies indicate significant unrealised potential for food processing across categories in India. India consumes less than 10 per cent of food across categories in the processed form compared to over 60 per cent in the U.S.

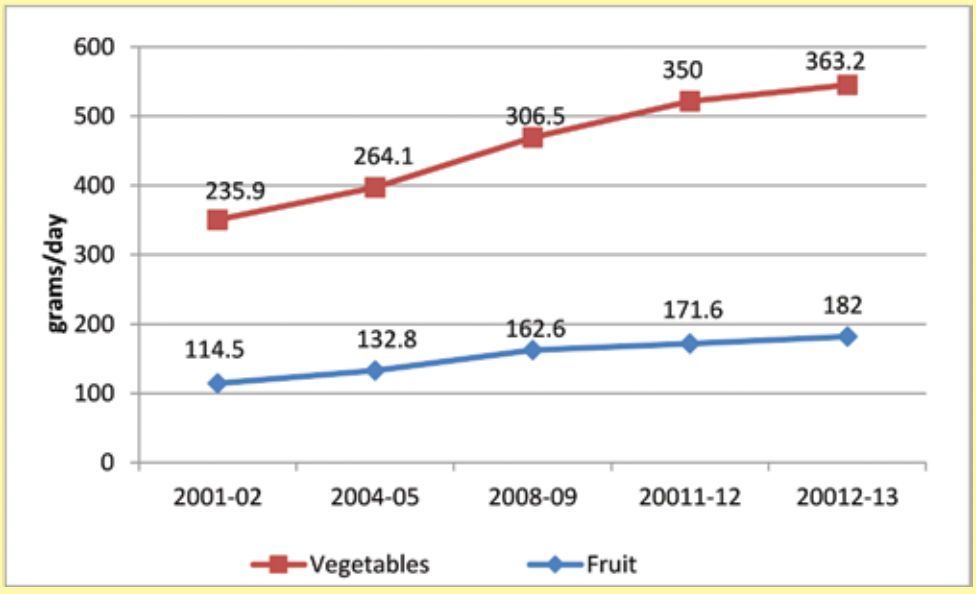
India permits 100 per cent FDI under the automatic route in the food processing industry and in food infrastructure including food parks, cold storage chain and warehousing. New units in fruits and vegetables processing enjoy a five-year tax holiday. With these incentives, the industry has, over the last few years, shown positive growth in ready-to-serve beverages, fruit juices and pulps, dehydrated and frozen fruit and vegetable products, pickles, convenience, tomato products, vegetable-spice pastes, processed mushrooms and curried vegetables.

IV.9 Changing Profile of Consumer's Food Basket

The availability of fruits and vegetables in India is well above the requirement for a balanced diet for adults (both men and women) as per the dietary guidelines for Indians issued by the National Institute of Nutrition, Hyderabad, in 2010.

With rising income levels and fast urbanisation, consumers demand a healthy diet and diverse food items. Over the years, there has been a significant change in the consumption basket of the population. With higher earnings, consumers are spending more on fruits and vegetables and other high protein and energy foods. This is evident from the fact that per capita availability of fruits has increased from 114 gram/day in 2001-02 to 182 grams/day in 2013. The same is the case with vegetables; the per capita availability of vegetables has increased from 236 grams/day to 363 grams/day during the same period (Figure IV.15). The availability of fruits and vegetables in India is well above the requirement for a balanced diet for adults (both men and women) as per the dietary guidelines for Indians issued by the National Institute of Nutrition, Hyderabad, in 2010. The Institute has recommended 100 grams/day of fruits and 200 grams/day vegetables as part of a balanced diet for an Indian adult.

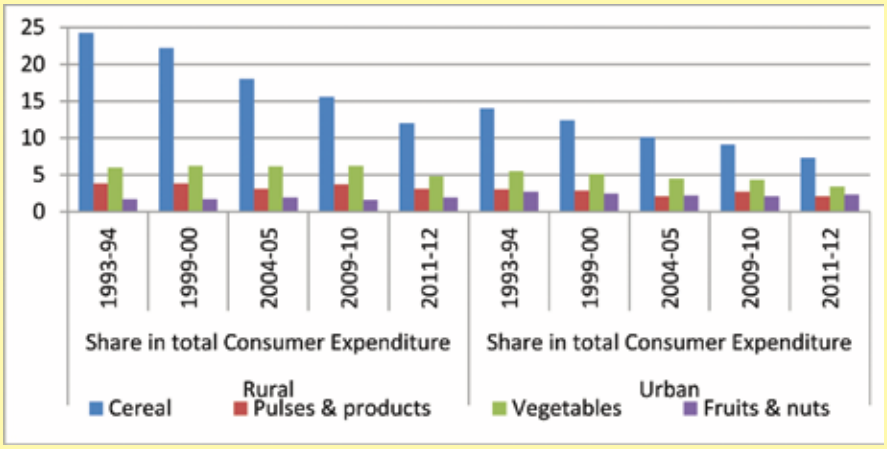
Figure IV.15: Per-capita Availability of Fruit and Vegetables



The composition of consumer spending on food is also changing fast (Figure IV.16). The share of spending on cereals including wheat and rice has come down significantly since

1993-94. Despite the increased per capita availability of fruits and vegetables in the country, the spending on fruit and nuts has been more or less stable but for vegetables, it has come down in recent years signifying easy availability of fruits and vegetables at lower prices. However, with higher prices for fruits and vegetables prevailing during the past one year or so, consumer spending on fruits and vegetables is likely to increase.

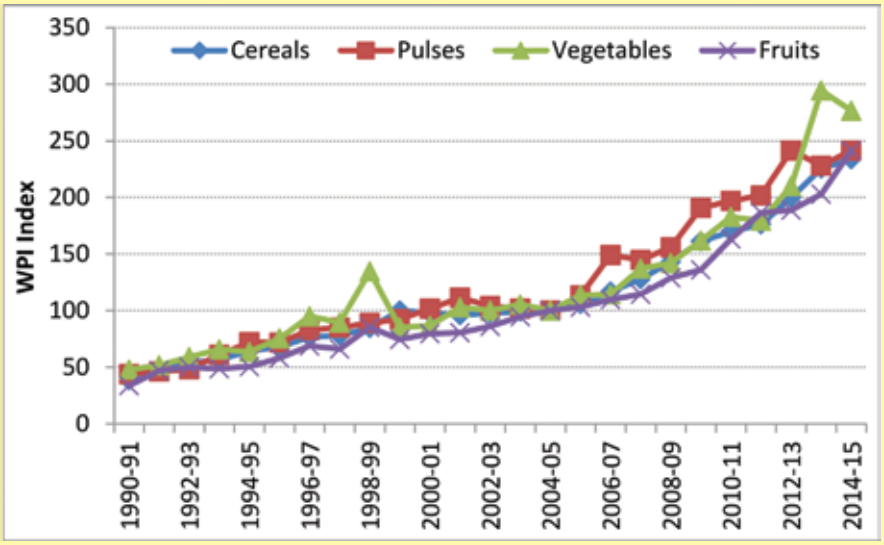
Figure IV.16: Trends in Percentage Composition of Consumer Expenditure since 1993-94 to 2011-12



IV.10 Price Trend in Fruit and Vegetables

The price volatility in vegetables is more pronounced as compared to fruits, perhaps because of the volatility in domestic production due to weather aberrations and international demand/supply mismatch, particularly for potatoes and onions. A significant upswing (y-o-y per cent change) in vegetables prices was seen almost every alternate year, the latest being during 2013-14. In the case of fruits, 1995-96-97, 1998-99, 2008-09, 2010-11 and 2014-15 recorded significant increases. There was a significant downward trend prices in the prices of both fruits (-12.6 per cent) and vegetables (-36.9 per cent) in 1999-2000. Figure IV.17 shows the trend in WPI of cereals, pulses and for vegetables and fruits since during 1991-92 to 2014-15.

Figure IV.17: Trend in WPI of Cereals, Pulses and for Vegetables and Fruits since 1991-92



The price volatility in vegetables is more pronounced as compared to fruits, perhaps because of the volatility in domestic production due to weather aberrations and international demand/supply mismatch, particularly for potatoes and onions.

As for international commodity prices, there are also wide fluctuations in the prices of rice and wheat among cereals and banana and orange among fruits since 1991. Figure IV.18 depicts trends of international commodity prices.

IV.11 Trade

A large number of fruits and vegetables are traded in the world market. India has a significant presence in the global trade in horticulture produce; yet, India's share in the global market is only around 1per cent. India exported Rs.14,365 crore worth of horticulture produce while it imported Rs. 5,284 crore worth of horticulture produce in 2013-14. There has been a significant increase in value terms in the export (46%) and import (21%) of horticulture produce in recent years. Among fresh vegetables, onions (61%) and among fresh fruits, grapes (32%) have recorded the highest growth in exports in 2013-14 compared to the previous year. Table IV.7 and Figure IV.19 show trends in the export of fresh fruits and fresh vegetables during the last three years.

Figure IV.18: Year-wise trends of International commodity Price Index: 1991-2015

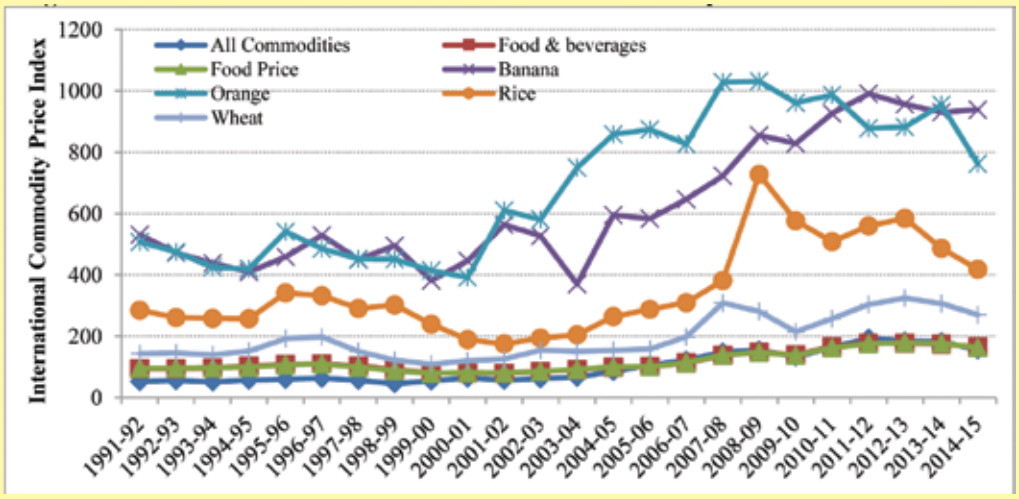


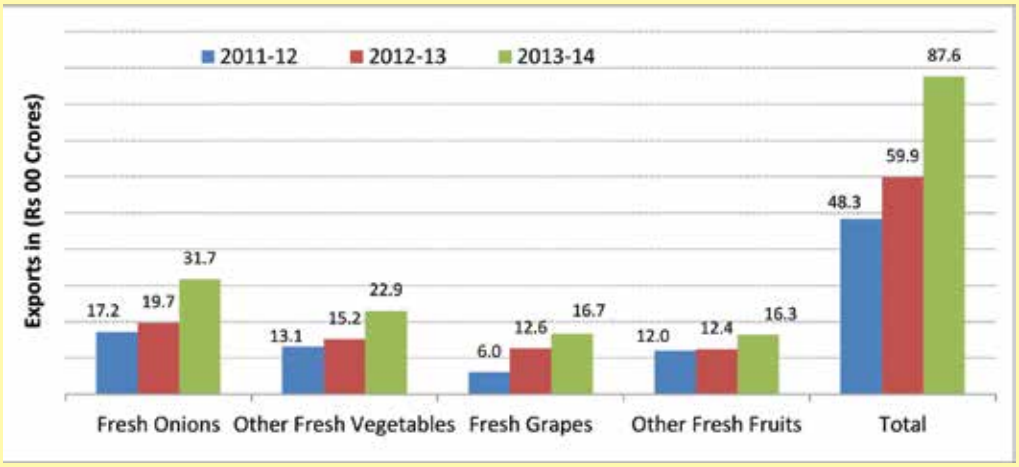
Table IV.7: Exports of Fresh Fruits and Vegetables during the last three years

Value: Rs. Crore, Qty: Million Tonnes

Product	2011-12		2012-13		2013-14		% growth over 2012-13
	Quantity	Value	Quantity	Value	Quantity	Value	
Fresh Onions	1309.9	1723.00	1666.9	1966.63	1482.5	3169.61	61.2
Other Fresh Vegetables	734.2	1310.48	768.6	1516.34	953.7	2293.32	51.2
Fresh Grapes	108.6	602.88	172.7	1259.43	192.6	1666.47	32.3
Fresh Mangoes	63.4	209.74	55.6	264.72	41.3	285.40	7.8
Other Fresh Fruits	276.3	986.50	269.3	979.58	247.3	1346.16	37.4
Total	2492.4	4832.60	2933.1	5986.70	2917.4	8760.96	46.3

Source: APEDA.

Figure IV.19: Growing Trend in Exports of Fresh Fruits and Vegetables during the 2011-14



Grapes, mangoes, walnuts, bananas and pomegranates account for the largest share of fruits exported from the country while onions, okra, bitter gourd, green chillies, mushrooms and potatoes contribute largely to the vegetable export basket. The major export destinations for Indian fruits and vegetables are UAE, Bangladesh, Malaysia, UK, Netherland, Pakistan, Saudi Arabia, Sri Lanka and Nepal.

India has also been exporting significant quantities of fruits and vegetables in processed form, particularly as dried and preserved vegetables (Table IV.8). Among fruits, mango pulp is the major export earner. There has been a 23 per cent increase in value terms in the export of processed fruits and vegetables during 2013-14 over the previous year.

Table IV.8: Exports of Processed Fruits and Vegetables during the last three years

Value: Rs. Crore, Qty: Million Tonnes

Product	2011-12		2012-13		2013-14		% growth over 2012-13
	Quantity	Value	Quantity	Value	Quantity	Value	
Cucumber and Gherkins (Prepared and Preserved)	258.6	745.03	238.6	856.5	9218.7	955.20	11.51
Dried & Preserved Vegetables	64.8	526.78	68.5	637.96	56.2	742.72	16.42
Mango Pulp	150.5	620.83	147.8	608.56	174.9	772.95	27.01
Other Processed Fruits & Vegetables	274.8	1577.60	269.2	1733.05	287.4	2266.60	30.79
Total	748.7	3470.24	724.1	3836.16	737.2	4737.47	23.5

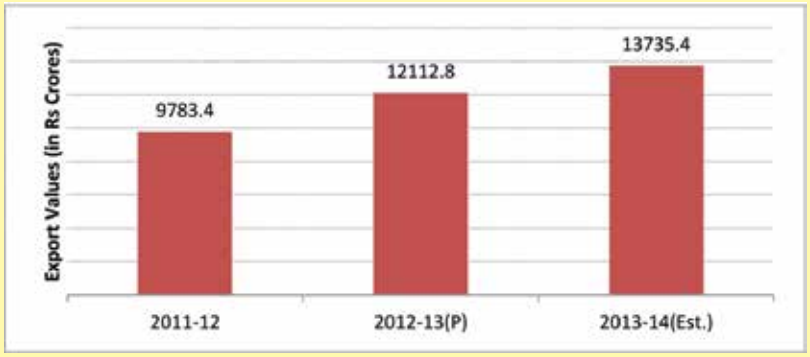
Source: APEDA.

India exported Rs. 13,735 crore worth of spices during 2013-14, an increase of 13 per cent over previous year (Figure IV.20). Major destinations for Indian spice exports include the USA, the European Union, Malaysia, China, Singapore, Sri Lanka, Japan and the Middle East.

India has also been exporting significant quantities of fruits and vegetables in processed form, particularly as dried and preserved vegetables.

India exported Rs. 13,735 crore worth of spices during 2013-14, an increase of 13 per cent over previous year.

Figure IV.20: Trend in Export of Spices from India (Rs. Crore)



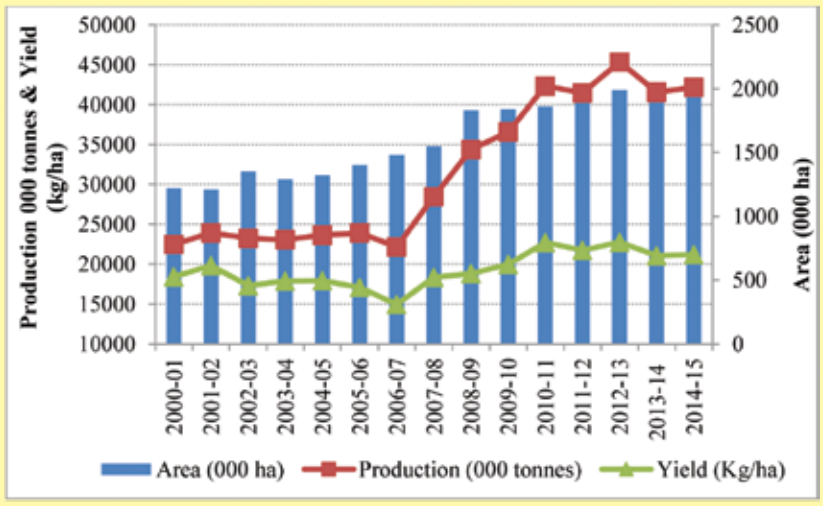
As for imports, the current foreign trade policy permits import of spices into the country without any quantitative restrictions except for items like 'seed quality' spices, fresh ginger and poppy seed. The import tariffs have also been gradually brought down. Under Free Trade Agreement with Sri Lanka, duty-free imports of spices are permitted. Duty-free imports are also allowed under the Advance Authorisation Scheme for value addition and re-export. India has been importing ginger (fresh and dry), pepper, cloves, poppy seed and cardamom (large) with total spice imports valued at Rs. 2,905 crore in 2013-14.

IV.12 Crop Specific Status of Some of the Important Vegetables and Fruits

IV.12.1 Potato

India is the second largest producer of potato after China with 42 million tonnes of production in 2014-15 grown over an area of 2 million hectares according to initial estimates by the National Horticultural Research and Development Foundation (NHRDF). Yield has increased to 21 tonnes/ha in 2014-15. Both production and yield of potatoes showed a declining trend until 2006-07 but from then on, it increased substantially and reached 42.3 million tonnes of production and 22.7 tonnes/ha of yield in 2010-11. Increase in potato production was largely due to an increase in the area under its cultivation. In recent years, there has been significant volatility in the production and yield of potatoes (**Figure IV.21**).

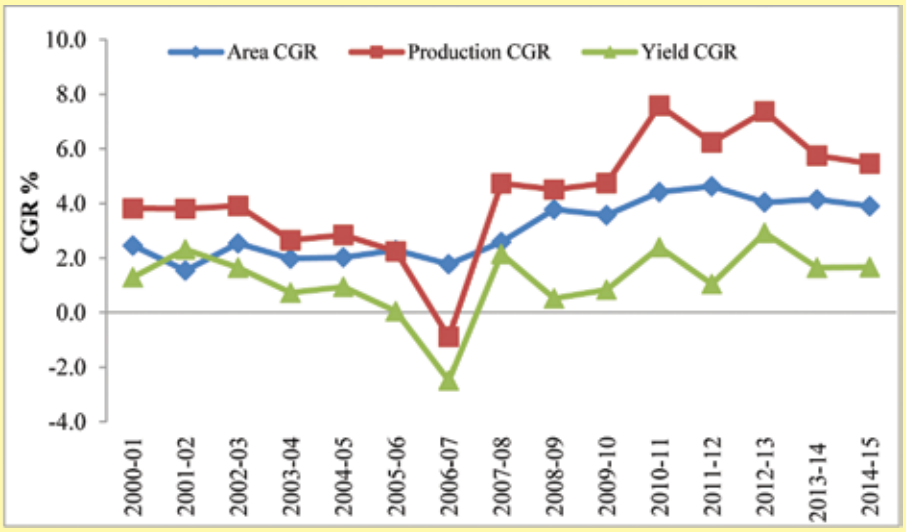
Figure IV.21: India - Area, Production and Yield of Potato



Source: National Horticulture Board.

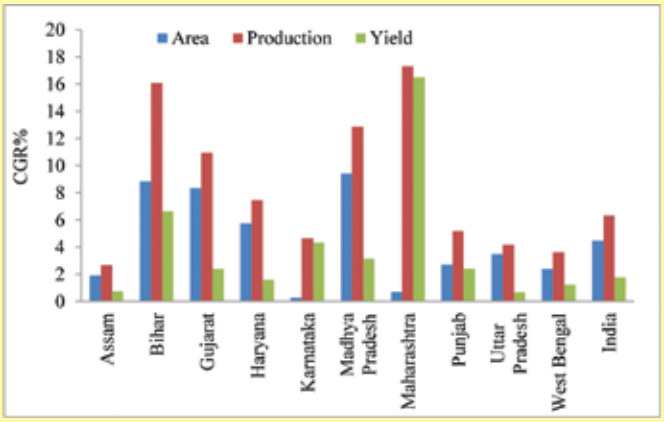
The trends in growth rates of area, production and yield of potato at national level shows a fall in 2006-07, whereas 2010-11 and 2012-13 reflect higher growth rate of 7.6 per cent in area and 7.4 per cent in production. The year 2013-14 and 2014-15 recorded declining growth rates in production and yield of potato **(Figure IV.22)**.

Figure IV.22: Trends in Growth (%) Area, Production and Yield of Potato at All India Level: Rolling Estimates for Previous 10-Years.



The state-wise trends in area, production and yield for potato from 2000-01 to 2014-15 show that Maharashtra (17.3 per cent), Bihar (16 per cent), Madhya Pradesh (12.8 per cent) and Gujarat (10.9 per cent) were among the states showing tremendous growth in production between 2000-01 to 2013-14. In these states, increased production resulted from not only an increase in area under potato cultivation but also from the introduction of new varieties, greater efforts to disseminate scientific crop husbandry practices, farmer friendly policies and improvement in marketing infrastructure. Assam registered the lowest CGR of 2.68 per cent during last decade (**Figure IV.23**). Although Uttar Pradesh and West Bengal are major potato producing states, these states recorded a lower growth rate of 4.1 per cent and 3.6 per cent, respectively in production during 2000 to 2014. As far as growth rates in yield are concerned, Maharashtra and Bihar top the list, whereas the lowest growth rates were registered in Assam and Uttar Pradesh.

Figure IV.23: Trends in Area, Yield and Production of Potato across States: Trend Growth Rates (%), 2000-01 to 2013-14



As far as growth rates in yield are concerned, Maharashtra and Bihar top the list, whereas the lowest growth rates were registered in Assam and Uttar Pradesh.

At the national level, the contribution of yield accounted for almost 86.4 per cent of the increase in potato production, whereas increased area accounted for 13.6 per cent.

An analysis of the contribution of area and yield to production change indicates that yield was the major contributing factor for production growth in almost all states except for Gujarat, where area was the most significant contributing factor **(Figure IV.24).** At the national level, the contribution of yield accounted for almost 86.4 per cent of the increase in potato production, whereas increased area accounted for 13.6 per cent.

Figure IV.24: Contribution of Growth Rate of Area and Yield to Growth Rate of Production of Potato: % 2000-01 to 2013-14

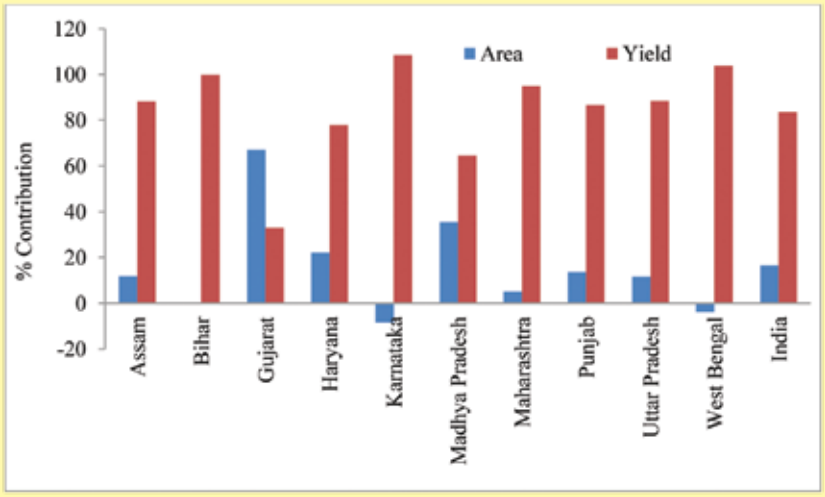
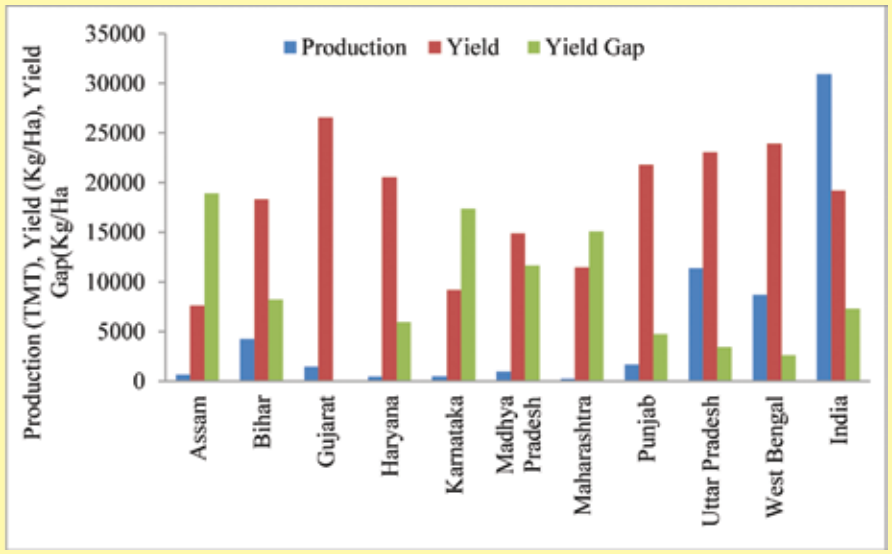


Figure IV.25 shows that the highest average yield of potato was in Gujarat at 26,514 kg/ha, followed by West Bengal and Uttar Pradesh. The deviation from the highest yield in various states ranged from 2,597 kg/ha in West Bengal to 18,907 kg/ha in Assam. Apart from West Bengal, the yield gap in other major potato producing states of Uttar Pradesh and Bihar is 3,442 kg/ha and 8,230 kg/ha respectively.

Figure IV.25: Pattern of Average Production (000 Tonnes), Yield (Kg/Ha) and Yield Gap (Deviation from Highest Yield) for Potato across States: 2000-01 to 2013-14



We have summarised the overall patterns that emerge from a review of trends and patterns of yield of potato at the state level in **Table IV.9**.

Table IV.9: Potato - Pattern of Growth and Variability in Yields during 2000 to 2014

Yield Growth	Yield	
	Low (←=17.5 tonnes/ha)	High (→17.5 tonnes/ha)
Low (←= 3% per year)	Assam, Karnataka	Uttar Pradesh, Gujarat, Punjab, West Bengal
High (→ 3% per year)	Madhya Pradesh, Maharashtra	Haryana, Bihar

Distribution of states by average yield and growth rate shows that Assam, Karnataka, Maharashtra and Madhya Pradesh come in the category of low average yield; among these states, Assam and Karnataka also show a lower growth rate in yield during 2000 to 2014. Other states that show lower growth rate but a higher average yield are Uttar Pradesh, Gujarat, Punjab and West Bengal. The decline in growth in productivity in some states is due to the decline in the water table, non-judicious use of fertiliser and low soil fertility. Yields in these states could be improved by resolving these constraints.

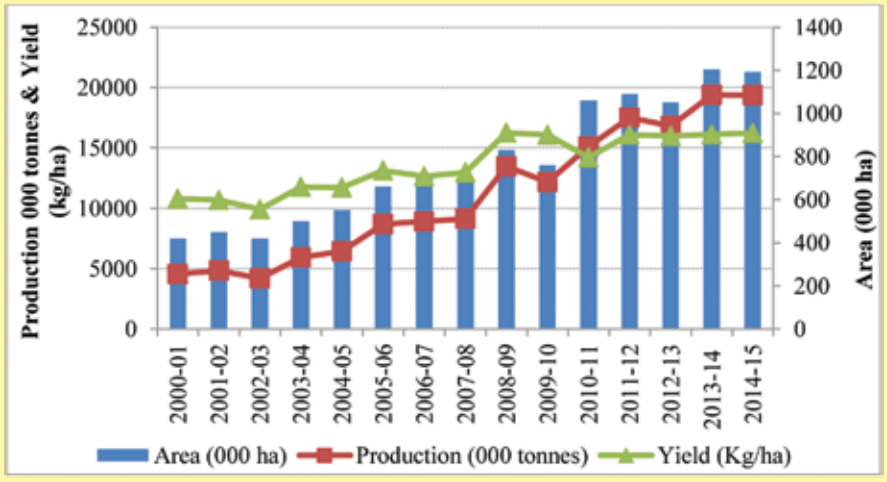
Haryana and Bihar fall in the category of states with high average yield and high growth. Maharashtra and Madhya Pradesh show higher growth in yield despite lower average yield, mainly due to the development and adoption of high yielding varieties and better cultivation practices.

IV.12.2. Onion

India is the second largest onion producer in the world after China. As per initial estimates by NHRDF, onion was cultivated in 1.19 million hectares in 2014-15, with a production of 19.36 million tonnes, the second highest production recorded since 2000-01. The highest production was in 2013-14, when production was 19.42 million tonnes (Figure IV.26).

Onion area and production has increased consistently during 2000-01 to 2014-15, except for 2009-10 and 2012-13, when there was a significant decline in production due to a decline in the area under cultivation. Onion productivity, despite an overall increasing trend, showed some fluctuation. However, over the last four years, productivity has stabilised after a substantial decline in 2010-11. Overall, the yield for onion has improved from 14.2 tonnes per hectare in 2010-11 to 16.2 tonnes per hectare in 2014-15.

Figure IV.26: India - Area, Production and Yield of Onions

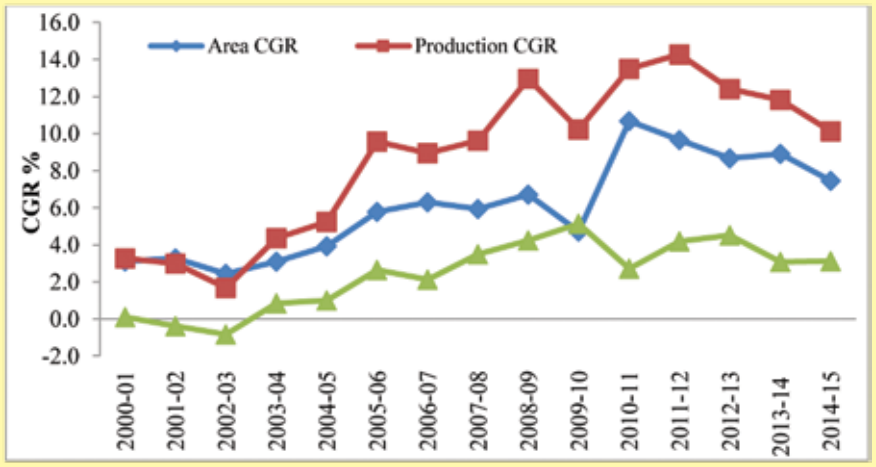


Source: National Horticulture Board.

The yield for onion has improved from 14.2 tonnes per hectare in 2010-11 to 16.2 tonnes per hectare in 2014-15.

In general, the compound growth rate of area and production of onions has shown an increasing trend up to 2008-09, except for the years 2002-03 and 2007-08, when it registered a slight decline. However, in 2009-10, both area and production of onion registered a significant fall, the reason being the unseasonal rains during the late *kharif* season. It picked up significantly in 2010-11, but since then, has been showing a declining trend. The productivity of onion showed a major fall in the year 2010-11 after showing an increasing trend in last decade. Since 2011-12, the area, production and yield of onion has been declining due to unseasonal rains resulting in huge losses. The decline in *production* is attributed to the drop in both *area* and *yield* (**Figure IV.27**).

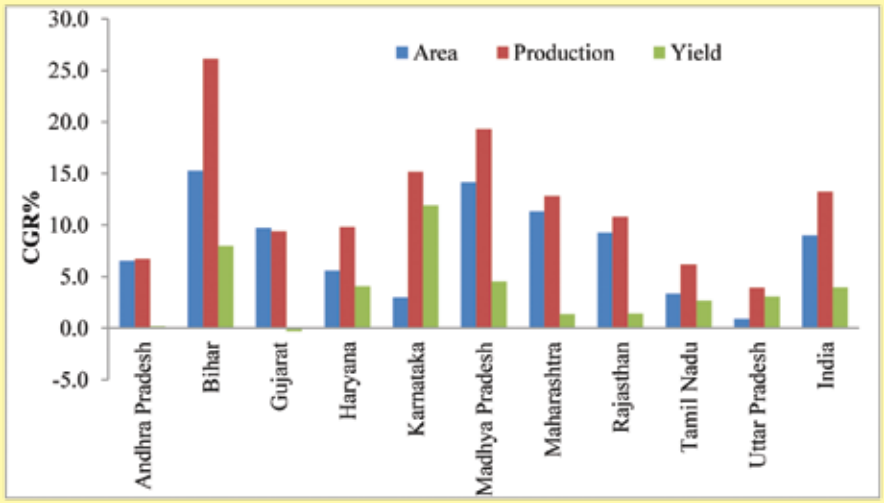
Figure IV.27: Trends in Growth (%) Area, Production and Yield of Onions at All India Level: Rolling Estimates for Previous 10-Years.



Maharashtra which is the largest onion producing state shows a compound annual growth rate of 12.8 per cent from 2000-01 to 2013-14, lower than the all-India growth rate of 13.2 per cent.

State-level data (**Figure IV.28**) shows the highest growth rate in production of onions was registered by high onion producing states like Bihar (26 per cent), Madhya Pradesh (19.3 per cent) and Karnataka (15.2 per cent). Maharashtra which is the largest onion producing state shows a compound annual growth rate of 12.8 per cent from 2000-01 to 2013-14, lower than the all-India growth rate of 13.2 per cent. States like Uttar Pradesh, Tamil Nadu and Andhra Pradesh registered the lowest growth rate in production during the last decade.

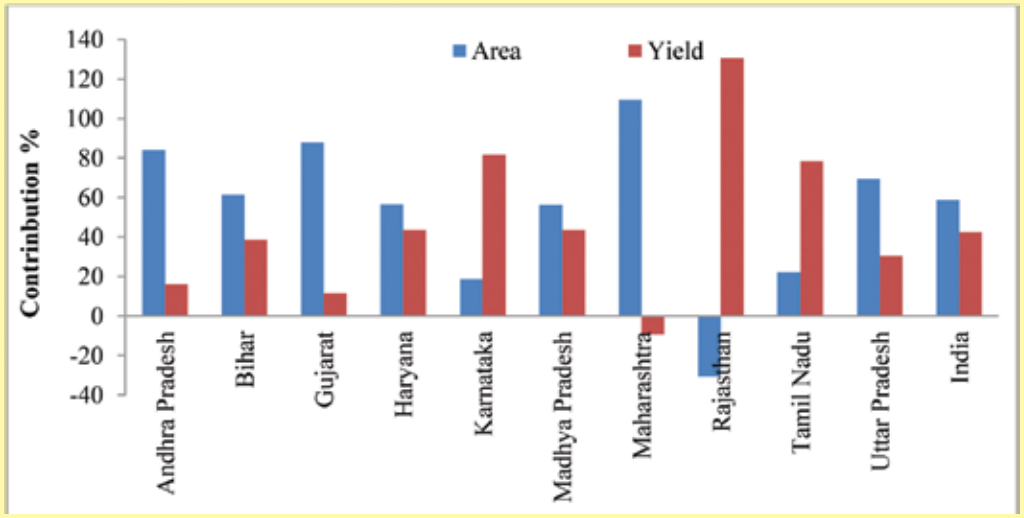
Figure IV.28: Trends in Area, Yield and Production of Onions by States



Yield growth rates were the highest in Karnataka, followed by Bihar. Madhya Pradesh and Haryana showed growth rates in productivity in the range of 4.0 to 4.5 per cent during 2000-01 to 2013-14, while other states showed a lower growth rate in yield. At the national level, the high growth in onion production was mainly attributed to area growth and to a lower extent to yield growth. At the national level, 58 per cent of the increase in production was contributed by area and 42 per cent by yield.

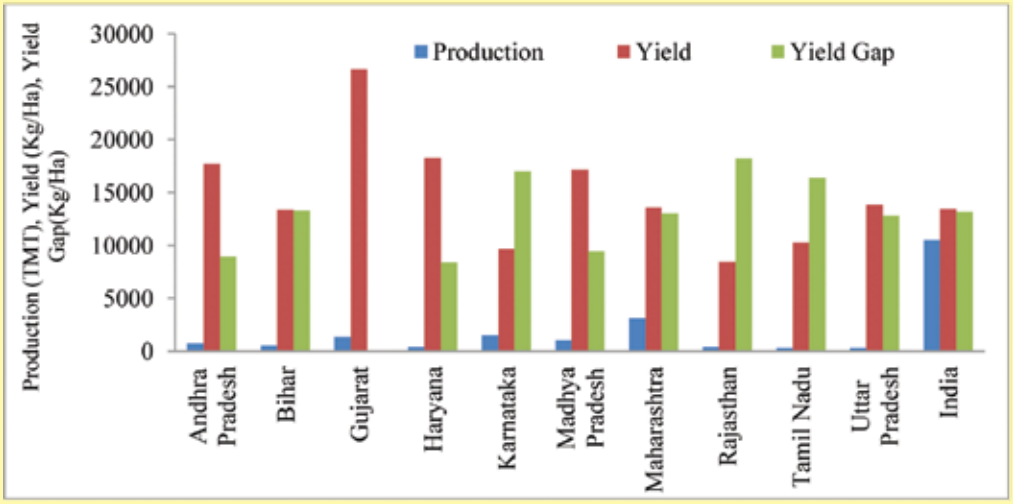
An analysis of the contribution of area and yield to production change at the state-level shows that, in most states except for Karnataka, Rajasthan and Tamil Nadu, area growth was the major contributor to production growth (Figure IV.29).

Figure IV.29: Contribution of Growth Rate of Area and Yield to Growth Rate of Production of Onions: per cent 2000-01 to 2013-14



The yield growth contribution to production growth was the highest in Rajasthan and the lowest in Gujarat (Figure IV.30). The yield gap (the difference between the sates' yield from the yield of the highest yield state) varies from as low as 8,382 kg/ha in Haryana to as high as 18,212 kg/ha in Rajasthan.

Figure IV.30: Pattern of Average Production (000 Tonnes), Yield (Kg/Ha) and Yield Gap (Deviation from Highest Yield) for Onions across States: 2000-01 to 2013-14



The yield growth contribution to production growth was the highest in Rajasthan and the lowest in Gujarat.

The overall patterns that emerge from a review of trends and patterns of yield of onions at the state level are summarised in **Table IV.10**.

Table IV.10: Pattern of Growth and Variability in Yields during 2000-01 to 2013-14: Onion

Yield Growth	Yield	
	Low (←=15 tonnes/hectare)	High (→15 tonnes/hectare)
Low (←= 3% per year)	Maharashtra, Uttar Pradesh, Tamil Nadu	
	Andhra Pradesh, Gujarat	
High (→ 3% per year)	Rajasthan, Bihar, Karnataka	Haryana, Madhya Pradesh

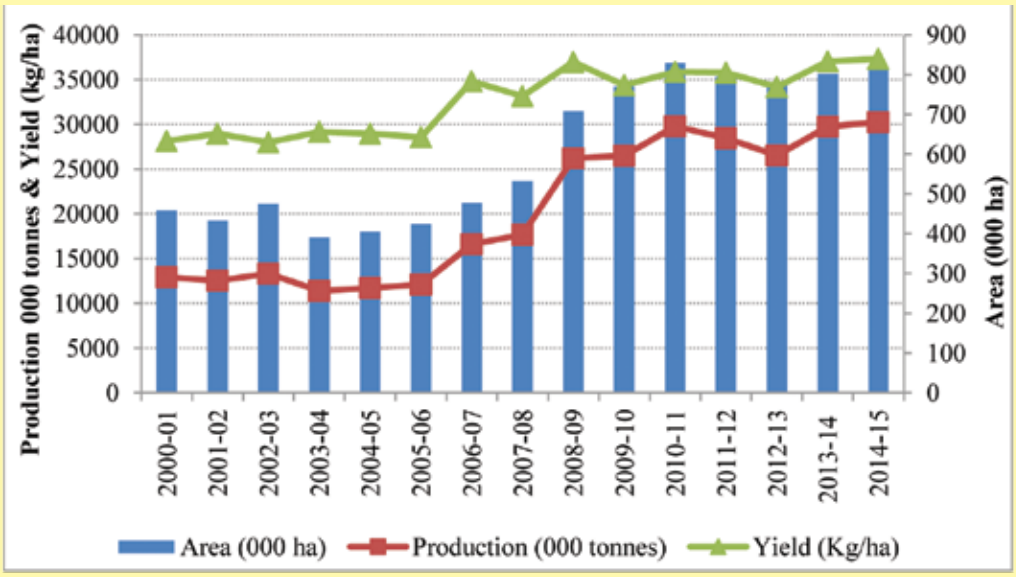
There are six states where average yield is lower than 15 tonnes per hectares, of which Maharashtra, Uttar Pradesh and Tamil Nadu also reflect lower growth rate in productivity, whereas Rajasthan, Bihar and Karnataka show higher growth rates. Among high onion productivity states, Haryana and Madhya Pradesh show higher growth in productivity.

India is the largest producer of bananas globally with 30.25 million tonnes of production from 811,000 hectares in 2014-15

IV.12.3 Banana

Banana is the second most important fruit crop in India after mango. India is the largest producer of bananas globally with 30.25 million tonnes of production from 811,000 hectares in 2014-15 (First Advance Estimates). Yield per hectare was 37.29 tonnes/ha. The area under and production of banana generally reflects an increasing trend during 2000-01 to 2014-15, except for recent years, particularly after 2009-10 when growth rate stagnated. Productivity growth has been more or less stable from 34.8 tonnes per hectare in 2006-07 to 34.1 tonnes per hectare in 2012-13. Thereafter, it picked up significantly in the last two years (**Figure IV.31**). Overall, the pattern of area, production and yield of banana reflect a stable trend from 2000 to 2006 after which, it increased till 2008-09. However, although there were significant improvements in the area under and the production and yield of banana, there were also large fluctuations in production due to vagaries of weather

Figure IV.31: Indian- Area, Production and Yield of Banana

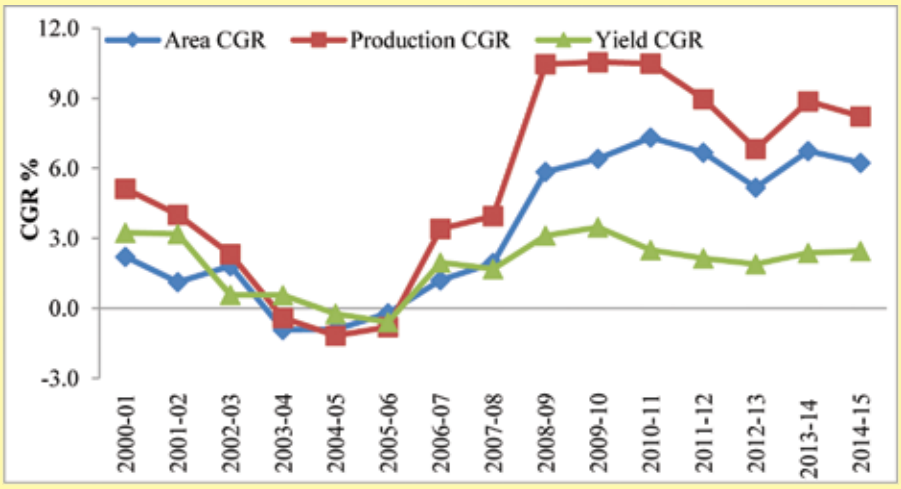


Source: National Horticulture Board.

There was a significant decline in production in 2012-13, due a decline in area attributed to unfavourable rainfall and lack of assured irrigation in major banana producing states. Although 2014-15 showed a decline in growth of area and production over 2013-14, the productivity showed a slight improvement (**Figure IV.32**).

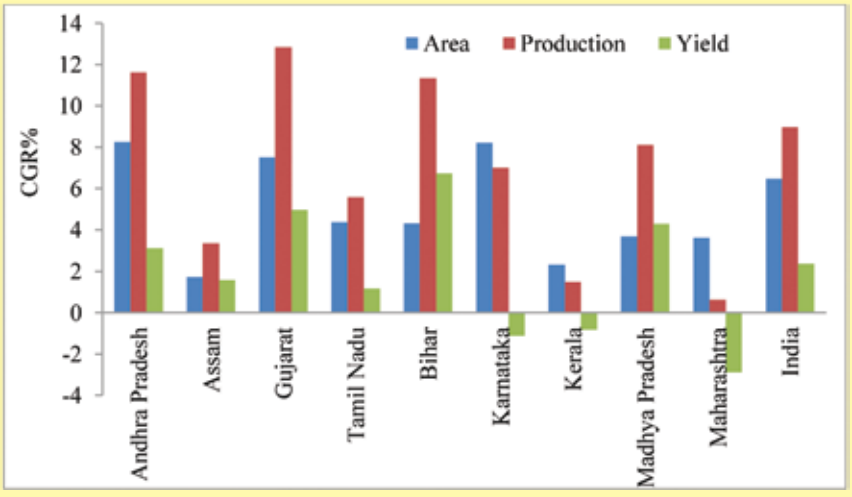
Figure IV.32: Trends in per cent Growth Rates of Area, Production and Yield of Banana

(Rolling Averages for Previous 10-Years)



State-wise trends in growth rates of production during 2001-2014 show the highest growth in Gujarat, followed by Andhra Pradesh and Bihar. Maharashtra, Kerala and Assam show the lowest growth in production during this period (**Figure IV.33**). The growth rate in area under banana cultivation is the highest in Andhra Pradesh, Karnataka, and Gujarat. Maharashtra, Kerala and Karnataka registered a negative growth rate in productivity, while Bihar, Gujarat and Madhya Pradesh registered highest growth rates. Tamil Nadu was the largest banana producing state in 2013-14, followed by Maharashtra, Gujarat and Andhra Pradesh. Production growth at national level is mainly driven by growth in area.

Figure IV.33: Trends in Area, Yield and Production of Banana across States: Trend Growth Rates (%), 2000-01 to 2013-14

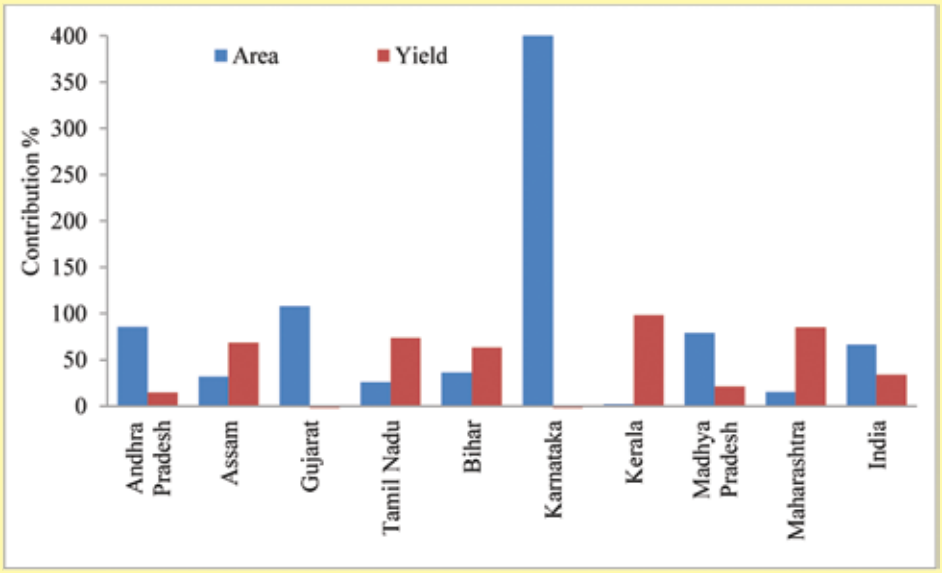


Nearly two-thirds of production growth is contributed by the growth in area at the all-India level, while one–third is from increase in productivity.

Nearly two-thirds of production growth is contributed by the growth in area at the all-India level, while one–third is from increase in productivity. In Maharashtra, Bihar, Assam, Tamil Nadu and Kerala, the contribution of yield to production is larger than that of area. (**Figure IV.34**).

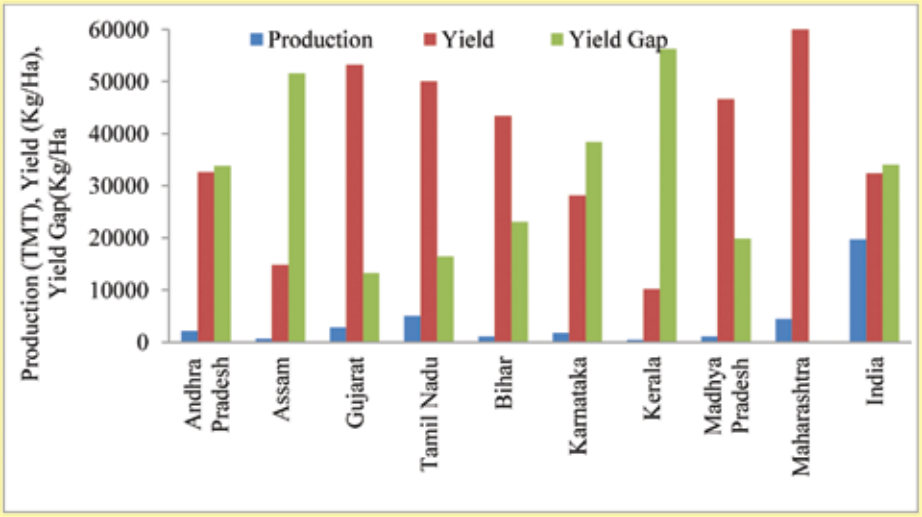
Figure IV.34: Per cent Contribution of Area and Yield to Production Growth of Banana

(2000-01 to 2013-14)



Among the major banana producing states, the highest average yield was registered in Maharashtra, followed by Gujarat, Tamil Nadu and Madhya Pradesh. Tamil Nadu and Maharashtra also showed the highest average production (**Figure IV.35**). The yield gap is the highest in Kerala, Assam, Karnataka and Andhra Pradesh, ranging from 13.3 tonnes /ha in Gujarat to 56.3 tonnes /ha in Kerala.

Figure IV.35: Average Production ('000 Tonnes), Yield (Kg/Ha) and Yield Gap (Deviation from Highest Yield) for Banana across States (2000-01 to 2013-14)



The distribution of states by average productivity and growth in the yield of banana is summarised in **Table IV.11**. Maharashtra and Tamil Nadu, which account for the largest banana production in India, show on an average higher productivity but lower productivity growth rates; this indicates the need for increased attention on yield improvement by focusing on improvement technology and assured irrigation. Andhra Pradesh, with low yield but high yield growth rates, also deserves attention because the state holds high production potential.

Table IV.11: Pattern of Growth and Variability in Yields during 2000-01 to 2013-14: Banana

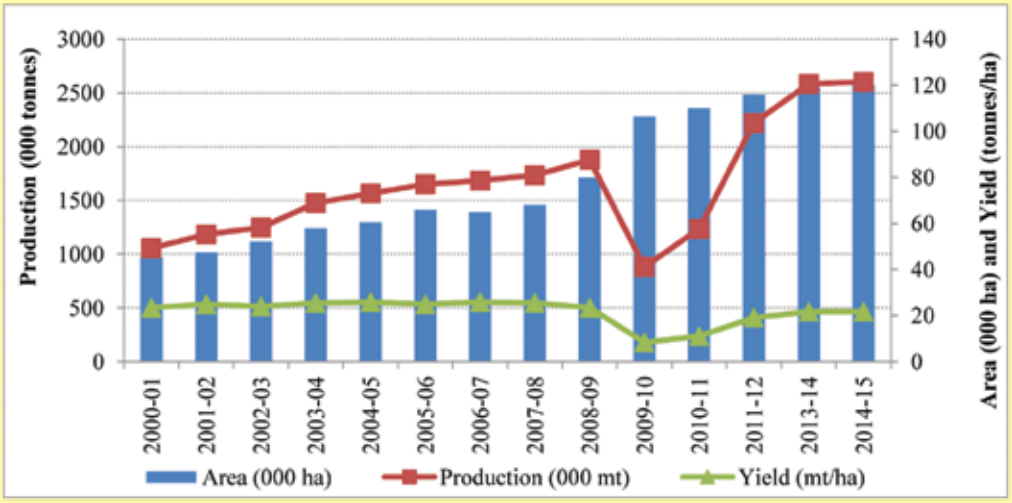
Yield Growth	Yield	
	Low (←=35 tn/ha)	High (→35 tn/ha)
Low (←= 2% per year)	Karnataka, Kerala, Assam	Tamil Nadu, Maharashtra
High (→ 2% per year)	Andhra Pradesh	Gujarat, Madhya Pradesh, Bihar

IV.12.4 Grapes

Grape is a commercially important fruit crop of India. It is a temperate crop, which has been adapted to the sub-tropical climate of peninsular India. India is among the first ten countries in the world in the production of grape. This crop occupies fifth position amongst fruit crops in India with a production of 2.62 million tonnes in 2014-15 from an area of 0.12 million hectares as per initial estimates of 2014-15 by NHRD **(Figure IV.36).** The area under grape is 1.6 per cent of the total area of fruit crops in the country and production 2.9 per cent of total fruit production.

Grape production followed an increasing trend from 2000-01until 2008-09; thereafter, it declined in 2009-10. From 2010-11 onwards again, it showed an upward trend except for the recent two years, when the production of grapes remained stagnant. The area under grape cultivation registered an increasing trend throughout the period, whereas productivity of grapes is lower now at 21.7 tonnes per hectare compared to 24.8 tonnes per hectare on an average during the years 2001 to 2009.

Figure IV.36: India - Area, Production and Yield of Grapes (2000-01 to 2014-15)



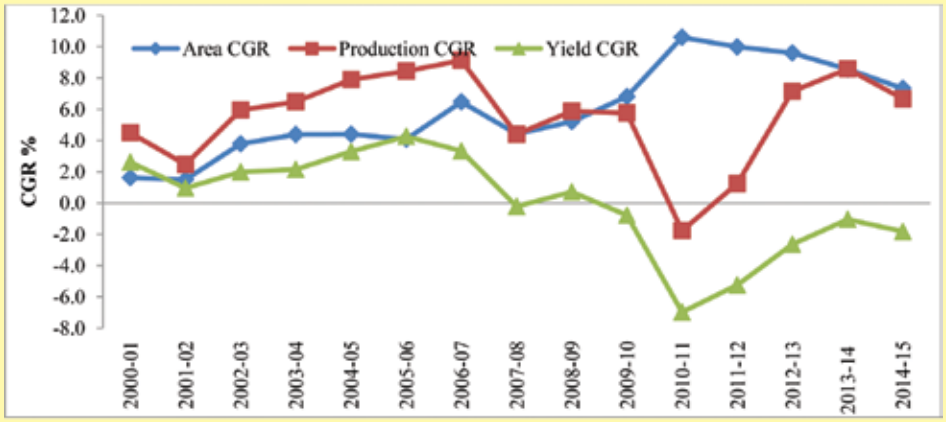
Source: National Horticulture Board.

The area under grape is 1.6 per cent of the total area of fruit crops in the country and production 2.9 per cent of total fruit production.

The area under grape cultivation registered an increasing trend throughout the period, whereas productivity of grapes is lower now at 21.7 tonnes per hectare compared to 24.8 tonnes per hectare on an average during the years 2001 to 2009.

The growth trends in area, production and yield of grapes reflects wide fluctuations after 2006-07 (**Figure IV.37**). The compound growth rate shows that the production and yield of grapes declined significantly in 2007-08, mainly due to decline in area. The growth in area under grapes was the highest in 2010-11 but ironically, growth in production and yield of grapes during the year was negative because of unseasonal rains in the largest grape producing states inflicting heavy losses. From 2011-12 onwards, growth in the area under grape reflects a consistent decline, while production and yield show an increase until 2013-14. The year 2014-15 shows lower growth rate in production and productivity.

Figure IV.37: India - Trends in Growth (%) of Area, Production and Yield of Grapes (Rolling Estimates Previous 10-Years)

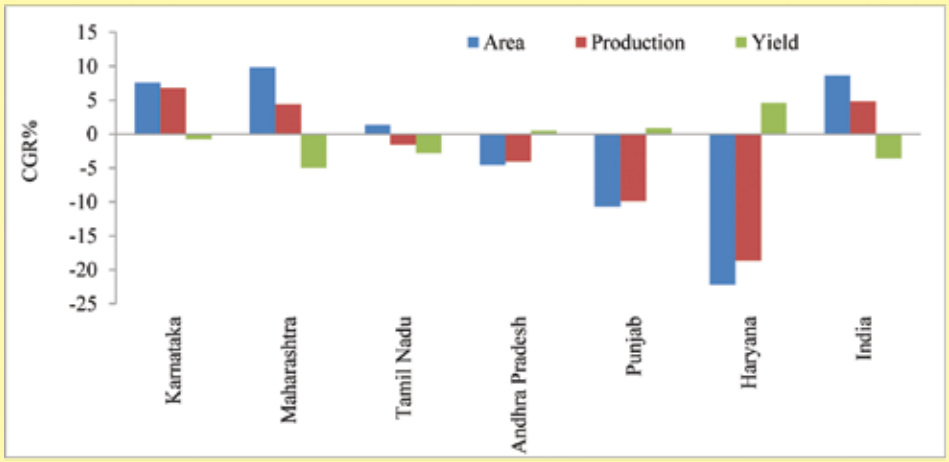


About 97 per cent of the production of grapes in 2013-14 was from Maharashtra, Karnataka and Tamil Nadu.

About 97 per cent of the production of grapes in 2013-14 was from Maharashtra, Karnataka and Tamil Nadu. The highest growth in the production of grapes during 2000-01 to 2013-14 was in Karnataka, followed by Maharashtra, while Haryana and Punjab showed the highest fall in production growth rate. In case of area, the highest growth is registered in Maharashtra and Tamil Nadu (**Figure IV.38**). There was positive growth of area under grape cultivation in Karnataka also during this period. However, in terms of yield, all three major grapes producing states show negative growth, except Haryana, where productivity of grapes improved by 4.6 per cent in the period 2001 to 2014.

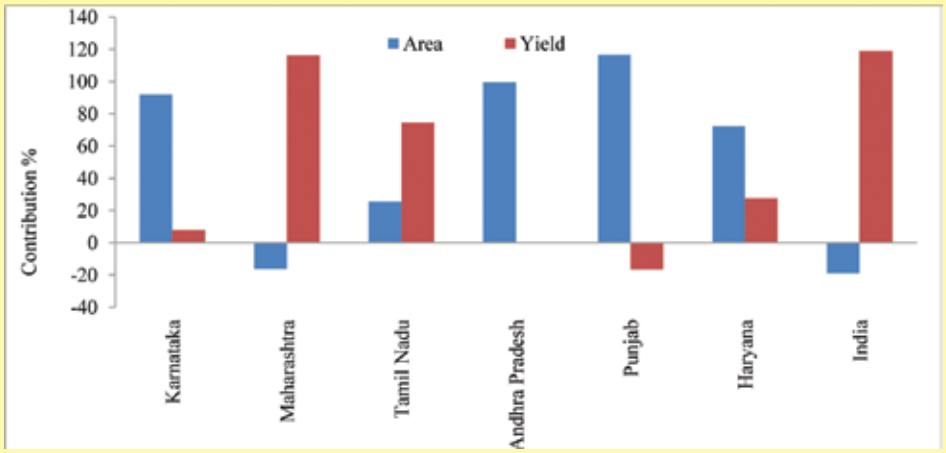
In terms of yield, all three major grapes producing states show negative growth, except Haryana, where productivity of grapes improved by 4.6 per cent in the period 2001 to 2014.

Figure IV.38: Area, Yield and Production Growth Rate (%) of Grapes across States: (2000-01 to 2013-14)



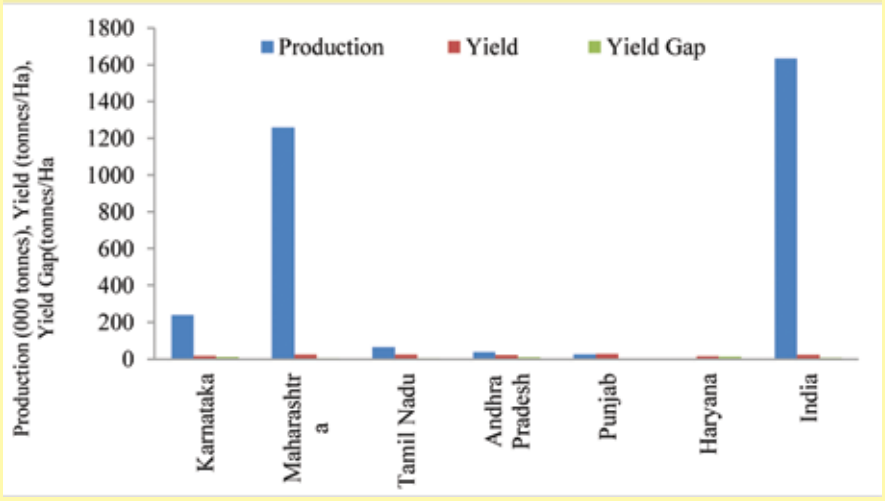
At the all-India level, the contribution of yields in increasing production is high than the increase in area (**Figure IV.39**). At the state level, increase in production was mainly attributed to change in yield for Maharashtra and Tamil Nadu, while in other states the main contributing factor was an increase in area.

Figure IV.39: Contribution of Growth Rate of Area and Yield to Growth Rate of Production of Grapes: % 2000-01 to 2013-14



While the average production of grapes is the highest in Maharashtra, Tamil Nadu and Karnataka, the average yield is the highest in Punjab followed by Maharashtra and Tamil Nadu (**Figure IV.40**). The yield gap ranges from 4.2 tonnes/ha in Tamil Nadu to 12.4 tonnes/ha in Haryana.

Figure IV.40: Average Production (000 tonnes), Yield (tonnes/Ha) and Yield Gap (tonnes/ha) for Grapes across States: 2000-01 to 2013-14



The pattern in yield growth and average yield are summarised in **Table IV.12.** It reveals that the three major grape producing states show low growth in yield. While Tamil Nadu and Maharashtra come in the category of high average yield, yield in Karnataka is low. Attention may be given to improve the yield. Andhra Pradesh, Haryana and Punjab, on the other hand, show high growth in yield, with Punjab also showing the highest average yield.

The yield gap ranges from 4.2 tonnes/ha in Tamil Nadu to 12.4 tonnes/ha in Haryana.

Table IV.12: Pattern of Growth and Variability in Yields during 2000-01 to 2013-14: Grapes

Yield Growth	Yield	
	Low (←=22 tonnes/hectare)	High (→22 tonnes/ha)
Low (←= 0.4% per year)	Karnataka	Tamil Nadu, Maharashtra
High (→ 0.4% per year)	Andhra Pradesh, Haryana	Punjab

IV.13 Medium-term Outlook

With rising income and urbanisation consumers in India are expected to demand better quality food items from the horticulture sub-sector as well. McKinsey and Co. and CII, in their joint study, have stated that 'with increasing affluence, both rural and urban population are likely to shift to better quality food items and demand more premium products.' The study further states that India's per capita fruit consumption is likely to grow to 90 kg per annum in 2030 as against 62 kg in 2010.

Our projected growth in domestic and export demand over medium term derived from expenditure elasticities and assumptions of population and income growth for potato and onion works out to 5 per cent and for banana 9 per cent per annum during 2014-21.

IV.14 Policy Recommendations

- India is still well below the level of productivity levels achieved by China, Brazil and western countries and it has to work towards bridging the yield gap for future production increases.
- There is significant unrealised potential for food processing across categories in India. India consumes less than 10 per cent of processed food in most categories whereas the US consumes over 60 per cent food across categories in the processed form. India needs to work towards popularizing processed fruits and vegetables by providing various incentives such as lowering the excise tariff.
- India needs to work aggressively for pre- and post-harvest technology improvement and management including creating facilities for temperature-controlled storage of horticulture produce.
- Market infrastructure and development of transport particularly in hilly regions is another area where additional efforts are needed.
- Development of hybrid and export oriented seeds for select fruit and vegetables need to be encouraged.

CHAPTER V

Summary, Conclusions, and Policy Recommendations

V.1 Summary

The global and India medium-term projection by four international institutions, namely the OECD/FAO, USDA, FAPRI, and IGC differ to some extent due to the assumptions made regarding various macroeconomic variables and the differing commodity coverage and projection period. Nevertheless, the global projection by the three agencies are generally in agreement with the FAO/OECD projections that have been summarised below:

- The potential for area expansion in the next decade (both globally and for India) is weak for most crops and production and growth will mostly be driven by yield increases.
- Demand for agricultural products is expected to remain firm although it will expand at a slower rate as compared to the previous decade.
- Growing incomes, urbanisation and change in eating habits are likely to contribute to the transition to diets that are higher in protein, fat and sugar content, both globally and in India.
- Prompted by increasing demand for livestock and bio-fuels, there is likely to be a shift in cropping pattern globally favouring coarse grains at the cost of wheat and rice.
- Crop prices are expected to drop during the next couple of years globally before stabilising at levels that remain above the pre-2008 period. However, in India, prices are likely to firm up for all commodities in rupee terms.
- The expected improved stocks-to-use ratio for cereals should alleviate concerns about their price volatility in the medium-term.

In the case of India, the conclusions drawn from the standalone COSIMO model and the econometric model developed by NCAER are more or less in line with the conclusion drawn from the models developed by the four international institutions.

Wheat

- India's production growth rate will be higher than the global growth rate. However, exportable surplus will fall because of increasing domestic demand.
- Per capita wheat consumption in India is projected to reach the global average in the next decade.

- Significant production growth in low-cost producing countries will make Indian wheat uncompetitive in the global market.
- The growth of India's wheat exports is projected to decline significantly. Some agencies project India will become a net importer, although a minor one, of wheat after 2016.
- Except OECD/FAO, which projects Indian wheat stocks to grow at a higher rate compared to the growth rate in global stocks, other agencies project a slower growth rate for Indian wheat stocks.
- OECD/FAO projects y -o-y growth rate of wheat prices in India (in rupee terms) to be much higher than global wheat price growth (in dollar term).

Rice

- The projected annual production growth rates for rice in India are higher than the global growth rate.
- The growth rate of rice consumption in India is projected to be higher than the global growth rate by most agencies.
- India's net rice export growth are is projected at much below the global growth rate and will face stiff competition in the global market from traditional exporters and new and emerging exporters such as Cambodia and Myanmar.
- Indian rice stocks are projected to increase at a higher growth rate than global stocks.
- OECD/FAO projects Indian rice price (in rupee terms) to increase at a higher rate than the global price increase in dollar terms.

Coarse grains

- All the agencies project Indian coarse grain production to grow at an annual compound growth rate that is well above the global growth rate, mostly driven by maize.
- Expanding poultry and dairy sectors will cause consumption to increase quite rapidly. On a per capita basis, Indian coarse grain consumption (human) is projected to remain significantly below world per capita consumption.
- Except for the OECD/FAO, and IGC, the other two agencies are rather pessimistic about India's coarse grain exports.
- India's coarse grain stocks are typically low and are projected to increase only modestly both by the USDA and FAPRI. However, OECD/FAO projections show a significant growth in India's total coarse grain stocks.
- OECD/FAO projects Indian overall coarse grain price to increase steadily at 1.5 per cent per annum to Rs. 25,281 per tonne in nominal terms by 2023, compared to the indicative global price of $225 per tonne (in real terms), which implies an annual growth rate of 1.44 per cent during the projection period .

Oilseeds

- Growing at an annual compound growth rate of 2.63 per cent, OECD/FAO projects India's total oilseed production to reach 32 million tonnes by 2023 from 24.6 million tonnes in 2013. Other agencies such as USDA, FAPRI, and IGC

project a lower total oilseed production growth rate for India.

- India's soybean production, which is increasing at 2.09 per cent annually, is projected to reach 13.6 million tonnes in 2023 by the USDA. FAPRI projects production 10.8 million tonnes in 2021 at a lower annual growth rate of 0.9 per cent. IGC projects soybean + rapeseed production in India to reach 20.3 million tonnes in 2019 at an implicit annual growth rate of 1.7 per cent.
- OECD/FAO projects India's total oilseed consumption/crush to grow at 2.52 per cent per annum to 31 million tonnes by 2023, compared to the global growth rate of 1.92 per cent. Taking soybeans only, India's consumption, mostly for crush, is projected to grow at 2.25 per cent per annum by USDA to 13.5 million tonnes by 2023 and at 0.59 per cent by FAPRI to touch 10.7 million tonnes in 2021.
- FAO/OECD projects India's net total oilseed exports to increase by a massive 12.7 per cent to 808,000 metric tonnes, presumably mostly HPS groundnut and small quantities of soybeans and rapeseed/mustard. However, USDA and FAPRI projections, which covers only soybeans, projects a decline in exports or to remain at the same level during the projection period.
- OECD/FAO projects India's total oilseed stocks to reach 1.9 million tonnes by 2023 at an annual growth rate of around 4 per cent. USDA and FAPRI projects soybean only stocks at 416,000 by 2023 and 479,000 by 2021, respectively.
- OECD/FAO projects Indian oilseed price to increase at an annual rate of 3.54 per cent to Rs. 51,664 per metric tonne in 2023 from Rs. 34,392 per tonne in 2013 (unclear price refers to which oilseed). This is significantly above the annual global total oilseed price growth rate of 0.15 per cent which will take the price to $ 522 per metric tonne in real terms.

Vegetable Oils

- OECD/FAO projects India's total vegetable oil production at 10.3 million tonnes by 2023, growing at 2.77 per cent per annum, a rate higher than the global growth rate of 2.16 per cent. USDA and FAPRI projections covers only soybean oil and project India's production at 2.1 million tonnes in 2023 at an annual growth rate of 2.49 per cent and at 1.7 million tonnes in 2021 at an annual growth rate of 0.76% respectively.
- OECD/FAO projects total vegetable oil consumption by India to increase by 3.81 per cent per annum to 27.6 million tonnes by 2023. On a per capita basis, India's total vegetable oil per capita consumption is projected to increase to 19.4 Kg per annum, approaching the global per capita consumption level of 21.1 kg. The implicit annual growth rate of per capita consumption in India is 2.69 per cent.
- India's total vegetable oil net imports are projected to increase annually by 3.81 per cent to 17.3 million tonnes in 2023 by OECD/FAO, significantly higher than the growth rate of global vegetable oil trade of 2.26 per cent due to a widening demand-supply gap. A major share of growth in total edible oil imports will be in non-soybean oils, mostly palm oil.
- OECD/FAO projects total vegetable oil stocks in India to grow annually by 1.59 per cent to 2 million tonnes by 2023, faster than the growth rate of global vegetable oil stocks of 0.72 per cent.
- Growing at 7 per cent per annum, India's indicative vegetable oil prices in nominal

terms are projected to skyrocket to Rs. 118, 019 per tonne in 2023, double the price level of 58,848 per tonne in 2013. The rate of increase will also be much above the annual global vegetable oil price growth rate of 1.46 per cent.

Sugar

- Indian sugar production is expected to increase at an annual rate of 2 per cent, higher than the expected annual rate of increase in global production of 1.8 per cent, to touch a level of 31 million tonnes in 2023, according to the OECD/FAO projection. FAPRI also projects Indian sugar production as rising at rate of 1.75 per cent to around 32 million tonnes in 2021.
- India's sugar consumption is projected by OECD/FAO to grow at 2.1 per cent to 32.4 million tonnes from 26.3 million tonnes in 2013, compared to FAPRI's sugar consumption projection growth rate of 1.58 per cent to 34.5 million tonnes in 2021 from a base level of 27.1 million tonnes in 2013. Both the projected rates are higher than the global sugar consumption growth rate. However, India's per capita annual sugar consumption is projected by OECD/FAO to remain below world per capita consumption throughout the projection period.
- According to OECD/FAO projections, India will remain a net exporter of sugar in some years and net importer in others. However, FAPRI expects India to remain a net exporter of sugar during the projection period ending 2021, registering an annual compound growth rate of 6.76 per cent.
- OECD/FAO projects India's sugar stocks to increase by around 0.7 per cent in a zigzag manner to reach 14.5 million tonnes by 2023. However, FAPRI projects Indian sugar stocks to grow at a steady rate of 1.77 per cent to reach 8.2 million tonnes in 2021, significantly below the OECD/FAO projection, throughout the projection period.
- Indian sugar prices in nominal terms is projected by OECD/FAO to increase in a cyclical fashion to reach around Rs. 64,000 per metric tonne in 2023, an annual growth rate of 4.8 per cent, significantly above the indicative global sugar price growth rate of 0.25 per cent, which will take the price to $519 per tonne in real terms in 2023.

Horticulture Crops

There are no international projections of production, consumption, trade, stocks and prices of horticultural crops such as potato, onion, and banana, both global and country specific. In this report, NCAER has made a review of the recent trends in horticultural commodities for these variables for major horticultural commodities in India.

V.2 Conclusions and Policy Recommendations

Although Indian crop yields for most commodities has shown an increasing trend in recent years, thanks to various government policies and programmes, yields of most crops in India with the exception of wheat are still significantly below world averages and yields and in many other countries in the region. Hence continued investment in research and development and extension services remain critical to achieve much needed productivity gains.

India typically receives adequate water supply through monsoon rains but large temporal and spatial variations in rainfall limit water availability leading to drought in some regions and floods in others. In the last one year, the government has injected different perspectives to many conventional models in which India operated, including in agriculture sector. The foremost is the Pradhan Mantri Krishi SinchaiYojana (PMKSY) a flagship irrigation scheme, when implemented, will ensure that all farm lands get water for cultivation reducing the dependency of Indian agriculture on monsoon, and mitigating the year-to-year yield fluctuations. In this context, inter-linking large rivers of India should also be taken up more seriously, although this would require a massive amount of political and financial capital.

India is blessed with ample supplies of solar energy, in particular at times that crops are at critical growth stages. Solar energy driven pumping sets is a viable alternative for electrical and diesel pumping systems in farm irrigation for farmers. The government is looking into the feasibility of implementing this project. Also the government has also launched nationwide 'Soil Health Card' Scheme for focusing attention on the health of soil in agricultural areas across the country, to boost productivity and bring about increased prosperity.

The government is also considering conversion of input and food grain subsidies into direct cash transfer, which should help plug subsidy leakages and ensure greater availability of funds for strategic public investment in areas such as irrigation, building of grain storage systems and cold chains.

India should strive to reduce the marginal cost of production of traditional export items such as rice (both coarse and basmati), wheat, maize, oilseeds and sugar to remain competitive in the world market.

The connection between the Indian domestic and international market is often weak because of policies such as market support pricing, state intervention, export restrictions, and tariff changes. Indian domestic commodity markets should get more and more integrated with global markets to take advantage of global market signals that could serve to guide farmers' crop selection.

The Prime Minister's recent initiative on integration of agri-markets across the country through the e-platform is seen as an important measure for overcoming challenges posed by the present agri-marketing system namely - fragmentation of State into multiple market areas each administered by separate APMC, multiple levy of mandi fees, requirement for multiple license for trading in different APMCs, licensing barriers leading to conditions of monopoly, poor quality of infrastructure and low use of technology, information asymmetry, opaque process for price discovery, high level of market charges, movement controls, etc. The need to unify markets both at State and National level is, therefore, clearly the requirement of time, in order to provide better price to farmers, improve supply chain, reduce wastages and create a unified national market through provision of the common e-platform.

Although private participation in developing agricultural infrastructure has increased, it has remained limited. The existing lack of agriculture infrastructure, such as storage, processing, cold chains and logistics calls for increased private or public private participation in these areas. Although the government has played a vital role in encouraging/aggregating private investment with policy announcements and

decisions and projects, foreign direct investment in food retailing continues to remain a contentious issue. FDI in food retailing will promote organised contract farming in catchment areas and could moderate the negative impact of shrinking farm holding size in India, provided contract farming is legalised.

The following are the commodity wise conclusions and recommendations:

Wheat: Competition from other major exporting countries, particularly from the CIS countries will make Indian wheat uncompetitive in the global market. However, because of its geographical advantage, India has potential to export wheat to neighbouring countries such as Bangladesh and Sri Lanka. India should establish grades and standards comparable with international standards to facilitate exports. There is also need to focus on cultivating durum wheat, which has better export prospects, in states like Punjab where yields are high and marginal cost is low.

Rice: Global rice trade will continue to expand relatively quickly in the next ten years, albeit at a lower rate than in the previous decade. However, Indian rice exports will face stiff competition in the global market, both from traditional exporting countries such as with Thailand and Vietnam and new emerging exporting countries such as Myanmar and Cambodia. Furthermore, the regular increase in the support price of paddy to compensate for increasing production costs could make Indian rice non-competitive globally. As Africa will continue to remain a major importer of rice, India should continue to focus on this market, where there is a preference for Indian medium quality rice. Efforts should be made to resolve sanitary and phytosanitary impediments with countries in this region such as Nigeria as well as countries like Iran, which are traditionally large markets for Indian rice. India's comparative advantage in basmati rice trade needs to be further exploited by increasing area under this variety and improving yields by introducing new higher yielding varieties. There is also need to improve the milling quality of rice if India is to remain competitive in the global market.

Pulses: Total consumption of pulses in the country is likely to continue to increase. As a result of a widening demand supply gap, pulse imports are anticipated to increase further in coming years. As India is the largest producer of pulses in the world with the largest area under this crop, a modest increase in yield through better seed distribution and extension effort to encourage practices such as growing pulses in the rice fallows, could make India self-sufficient in pulses and perhaps even help turn it into an exporter.

Coarse Grains: Whether India will remain an exporter or importer of coarse grains will depend on the future trend in coarse grain yields. There is already a large inter-state yield gap in maize. If the yield gap could be bridged through increased usage of hybrid seeds, India could emerge as a major exporter of maize, particularly to neighbouring countries such as Bangladesh and Sri Lanka. There is also a potential to expand production and export of other coarse grains such as ragi, as there is increasing awareness of the nutritive value of such grains. Indian export development organisations such as APEDA should try to promote these crops in other nutrient conscious countries in the West and Japan.

Oilseeds and Vegetable Oil: As in the case of most other crops, oilseeds crop yields in India are low as compared to other countries although area coverage is much higher. Furthermore, as the crop is mostly grown in rain-fed areas, year-to-year fluctuations are high, aggravating demand-supply imbalances and significantly increasing imports in a poor monsoon year. A significant increase projected in palm oil production in Malaysia

and Indonesia should benefit India. However, strong demand for food and fuel is expected to result in increased global prices, making imports costlier. Further, policy changes regarding bio-fuel use in major producing countries could completely change the production outlook for these commodities. Hence, India should try to diversify its vegetable oil imports basket, sourcing soybean oil and sunflower seed oil. As India has a very large area under oilseed crops, a modest increase in yield through better seed distribution, better irrigation and extension efforts could make India self-sufficient.

Oilseed Meal: The price of protein meal is not projected to increase as much as vegetable oils in the world market, which will be disadvantageous for India, a major exporter of oil meals, particularly soybean meal. However, there is potential to export to neighbouring countries such as Pakistan, Bangladesh, Sri Lanka, and the Middle East, where India has a comparative advantage due to geographical proximity.

Sugar: In real terms, world sugar prices are expected to follow a moderately upward trend, and will continue to follow the familiar "sugar cycle", driven mostly by specific market conditions in Asia and Brazil. Because of the ever increasing cost of production of sugarcane in India, largely due to unrealistic farm support price fixation by states, the cost of sugar production in India will continue to remain high unless the pricing policy for sugarcane is rationalised on the lines recommended by the Rangarajan Committee. According to the Committee, the pricing formula should be based on linking the price of sugarcane to the revenue realised by sugar mills from the sale of sugar and first stage by-products such as molasses. The existing price policy and regulation in the sugar sector in India has resulted in low sugarcane productivity, and stifled profitability and modernisation of mills.

APPENDIX 1

Medium-term Projections by Various Agencies

Figure 1: India Wheat Production Projections

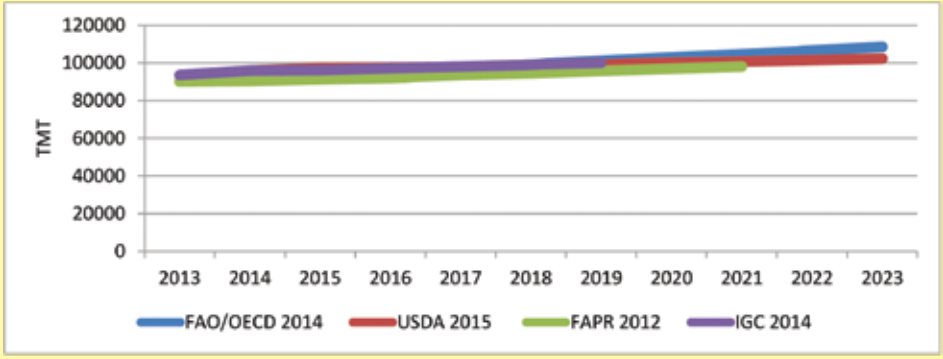


Figure2: India Wheat Consumption Projection

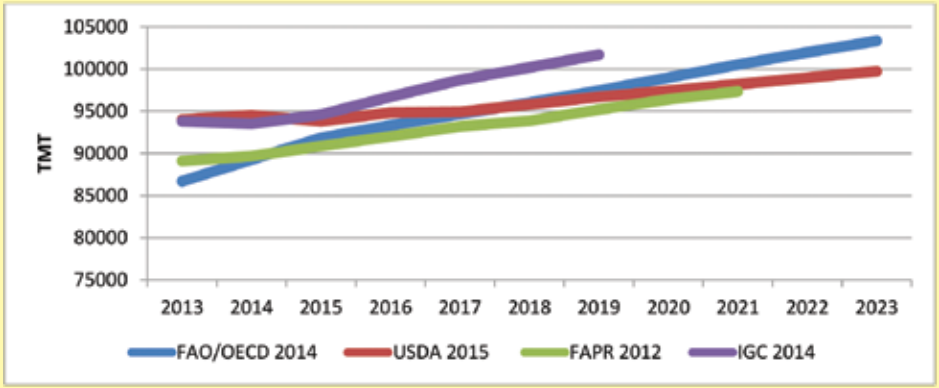


Figure 3: Per Capita Wheat Consumption – India vs. World

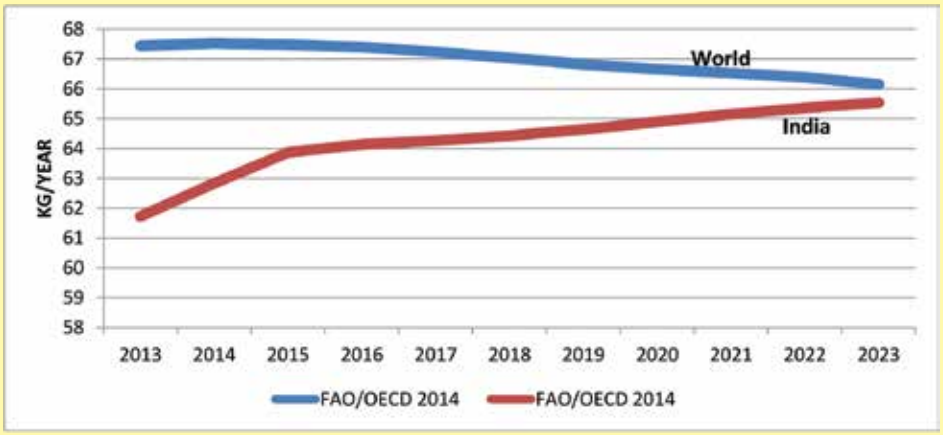


Figure4: India Net Wheat Export Projections

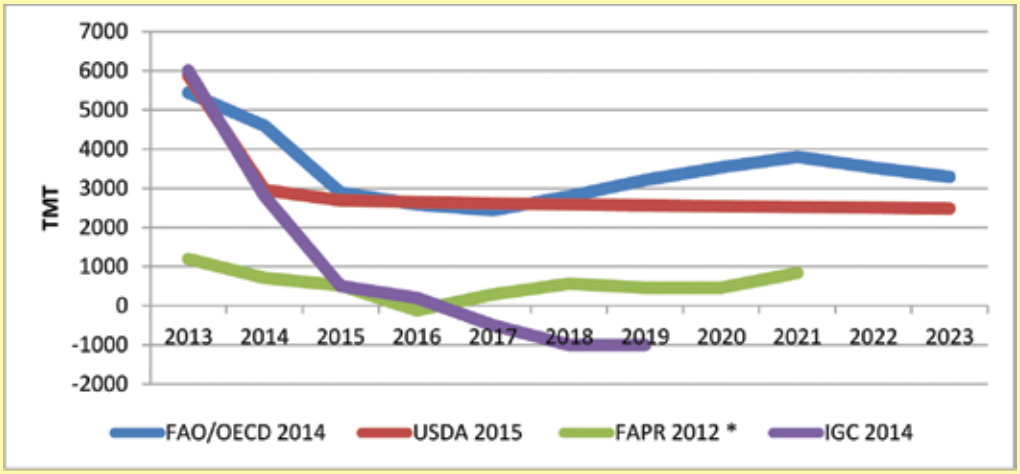


Figure 5: India Wheat End Stocks Projection

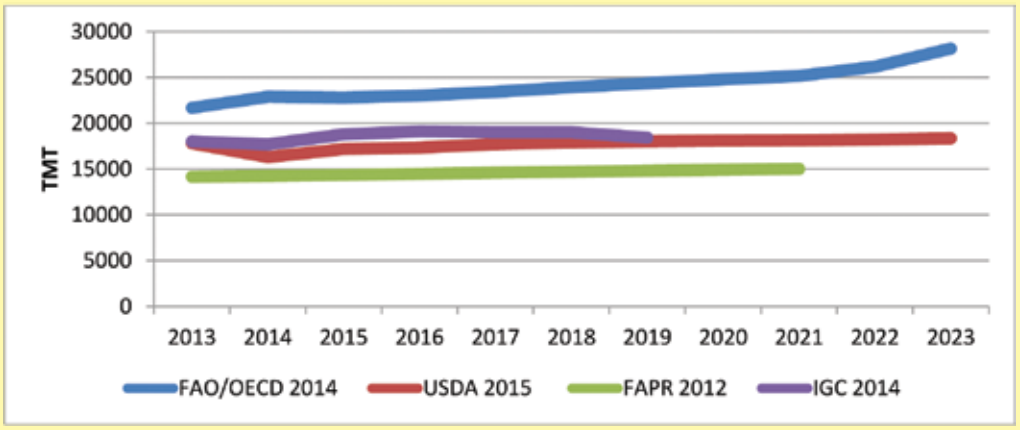


Figure 6: India Wheat Price Projection by OECD/FAO

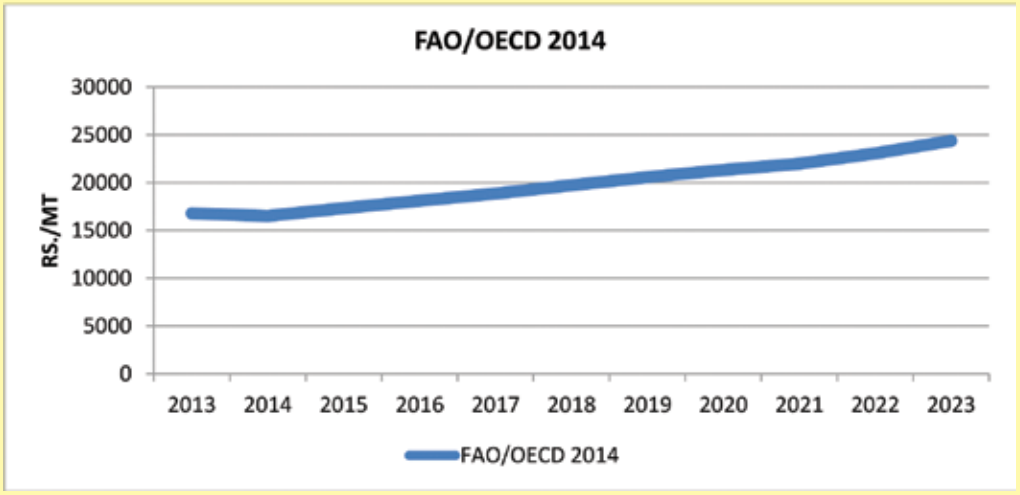


Figure 7: India Rice Production Projections

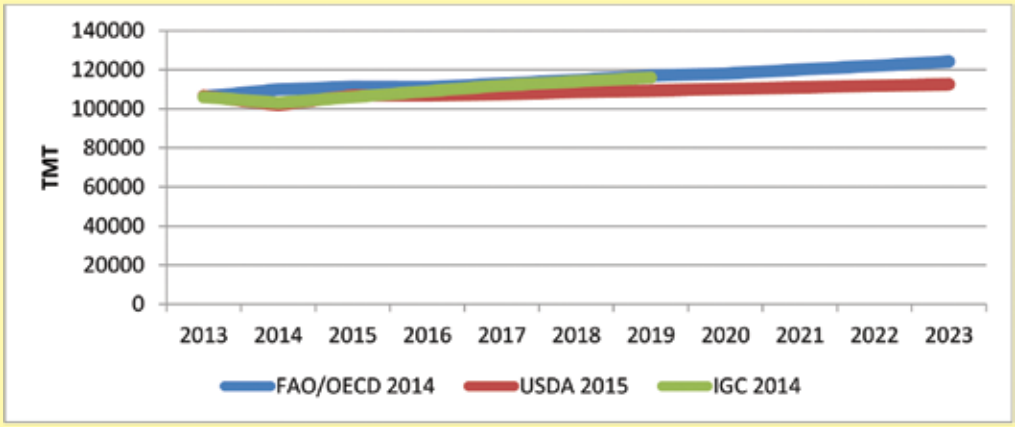


Figure 8: Per Capita Rice Consumption – India vs. World

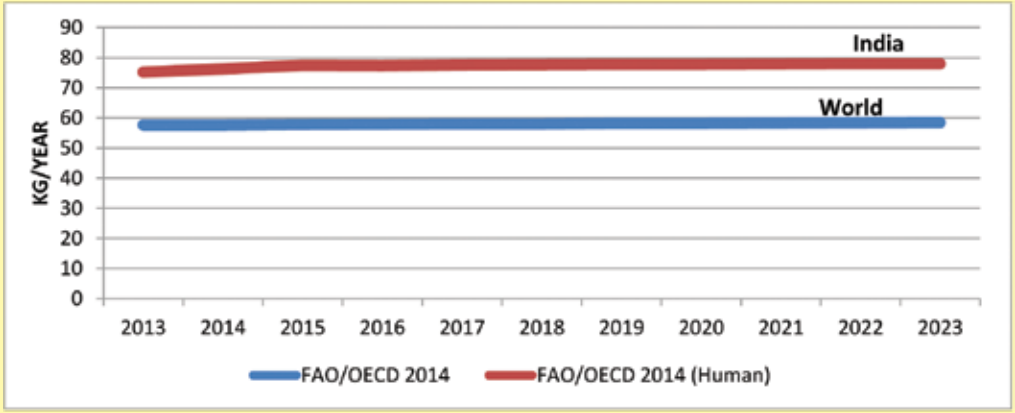


Figure 9: India Net Rice Exports Projection

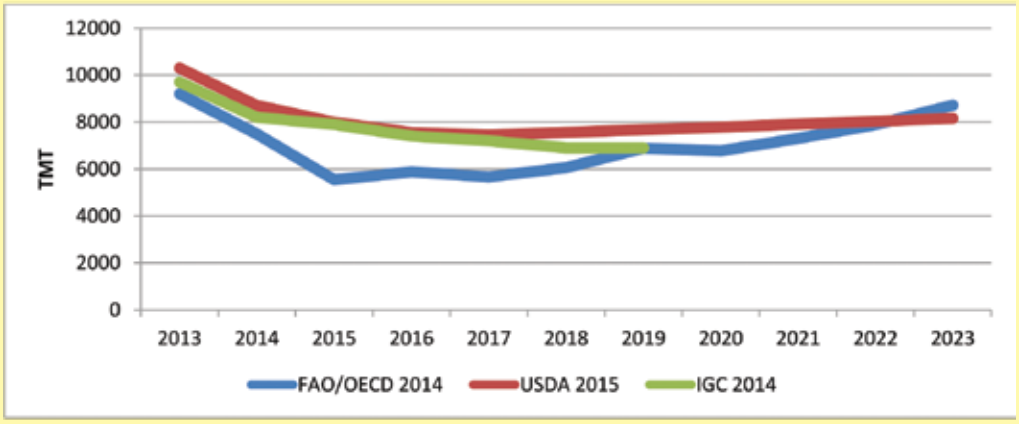


Figure 10: India Rice Stocks Projection

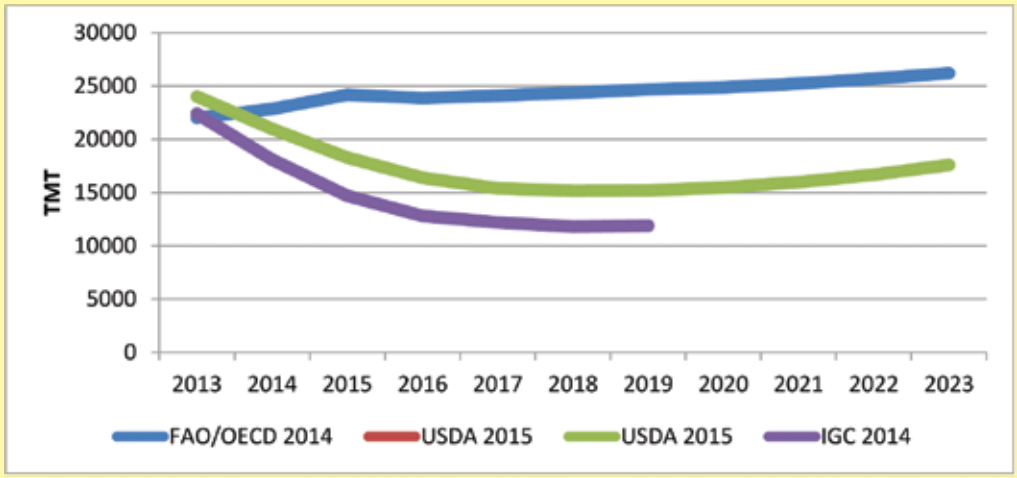


Figure 11: India Rice Price Projection by OECD/FAO

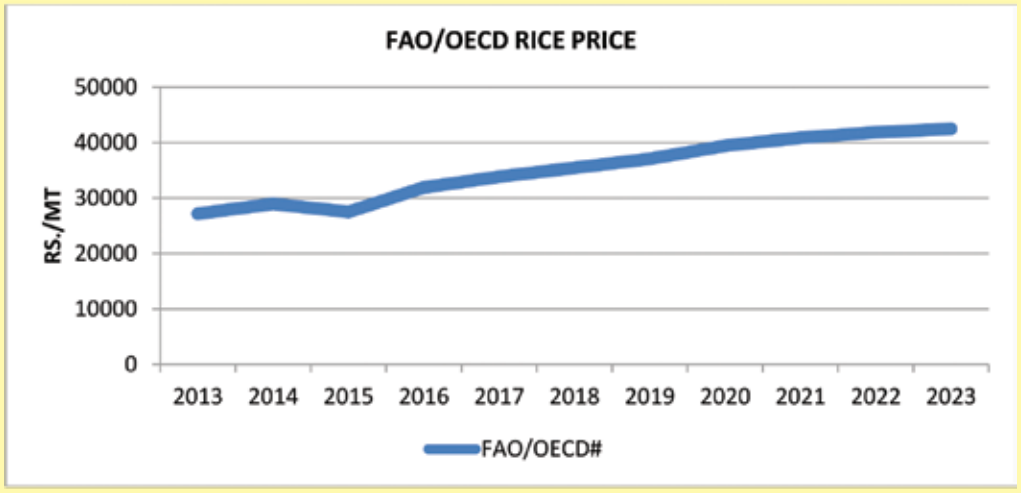


Figure 12: Total Coarse Grain Production Projection by Various Agencies

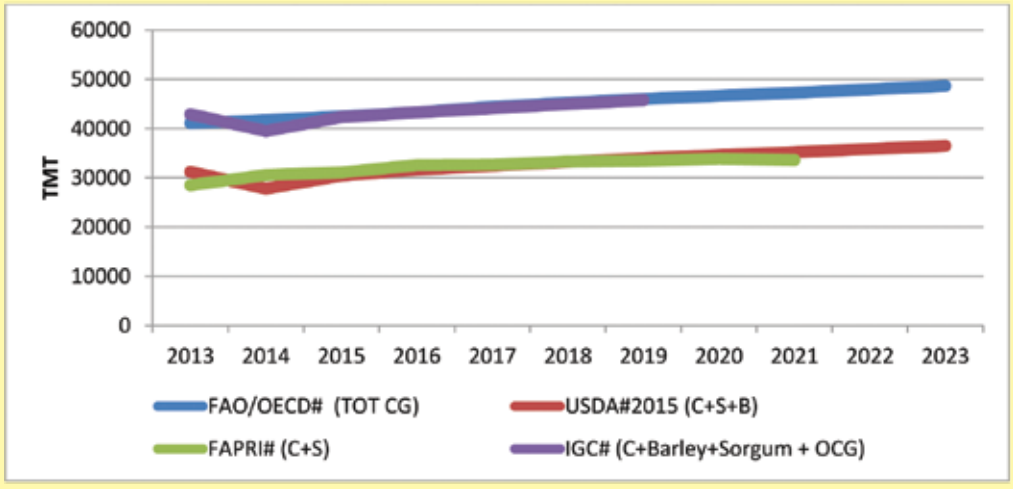


Figure 13: India Maize Production Projections by Various Agencies

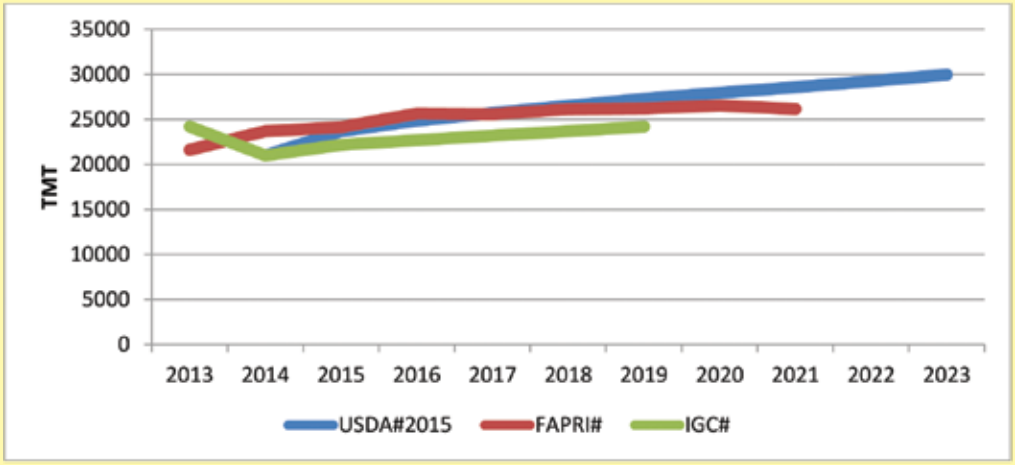


Figure 14: India Total Coarse Grains/Maize Net Exports

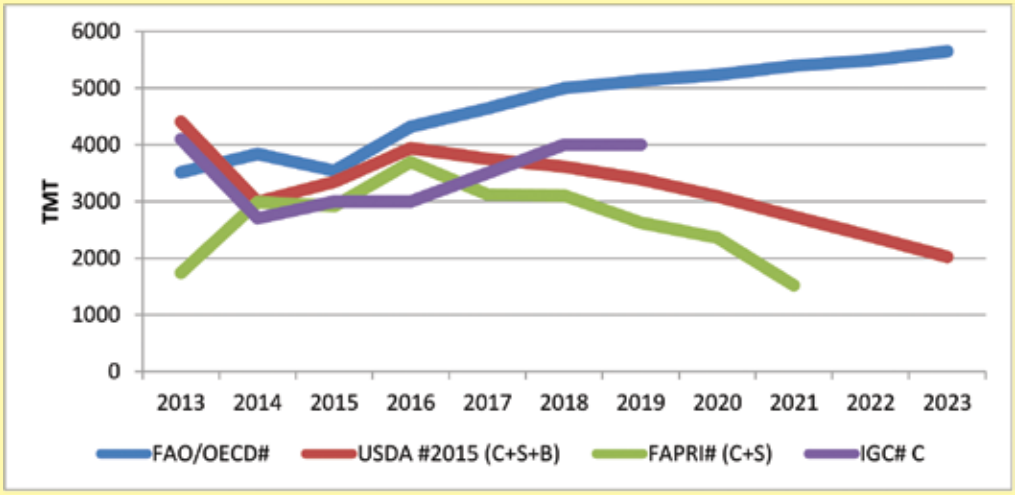


Figure 15: India Total Coarse Grains Stocks Projection

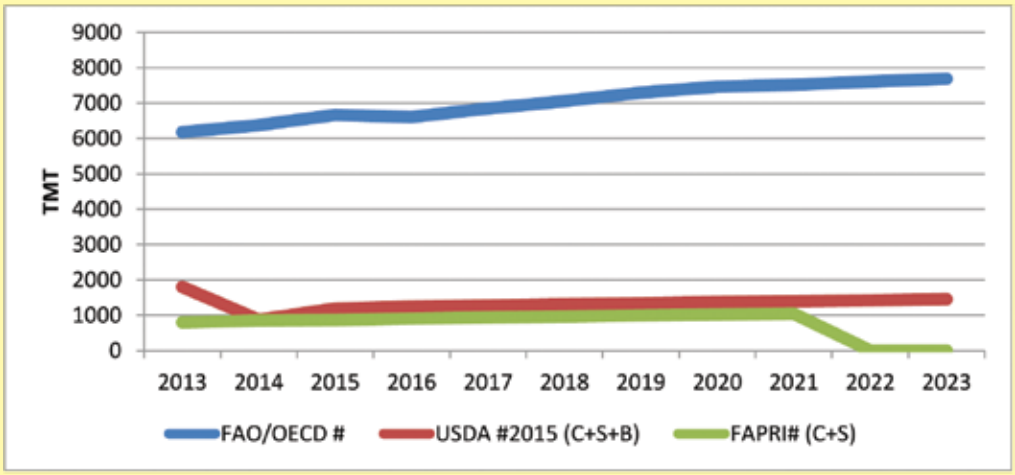


Figure 16: India Indicative Total Coarse Grain Price

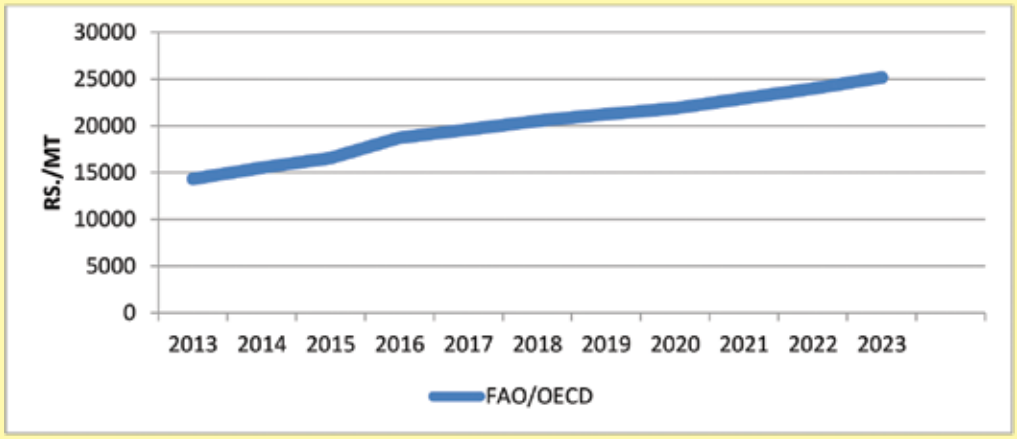


Figure 17: India Oilseed Production Projections by Various Agencies

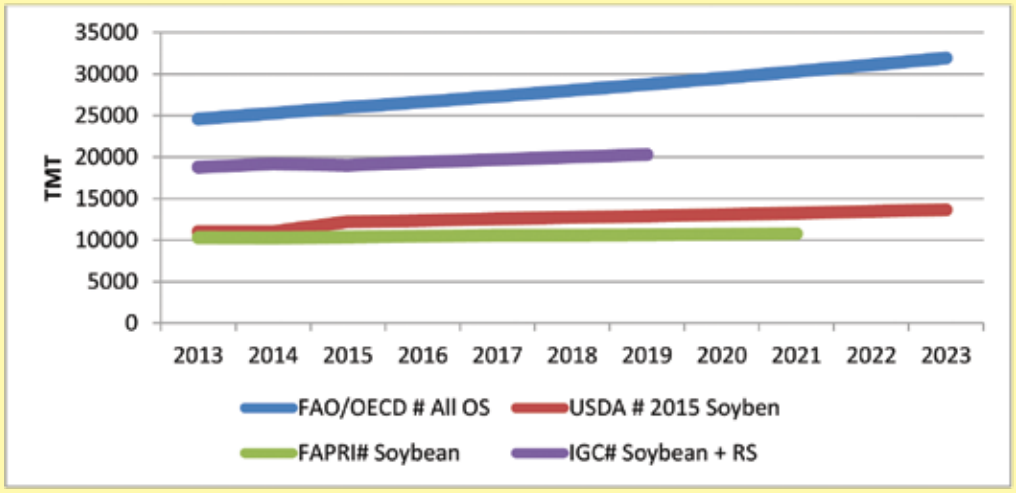


Figure 18: India Oilseed Consumption/Crush by Various Agencies

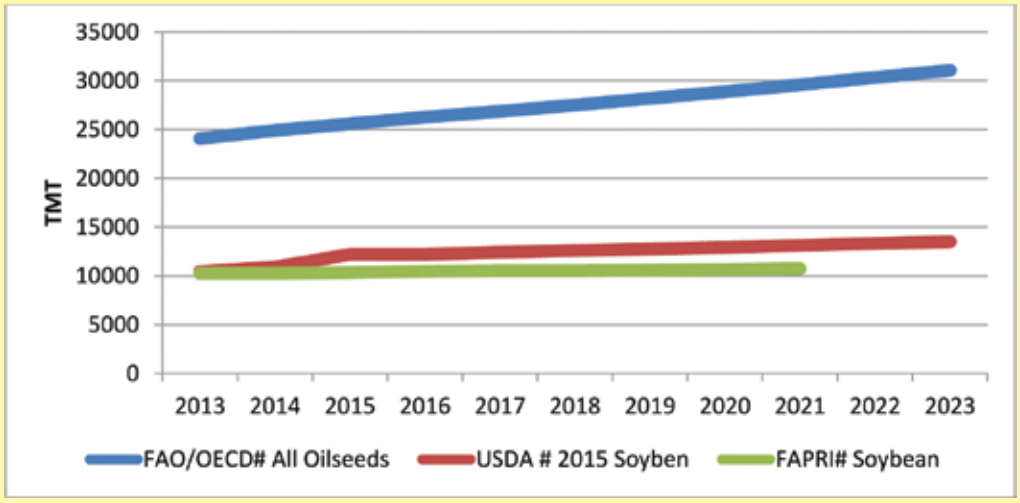


Figure 19: India Net Exports of Total Oilseeds and Soybeans

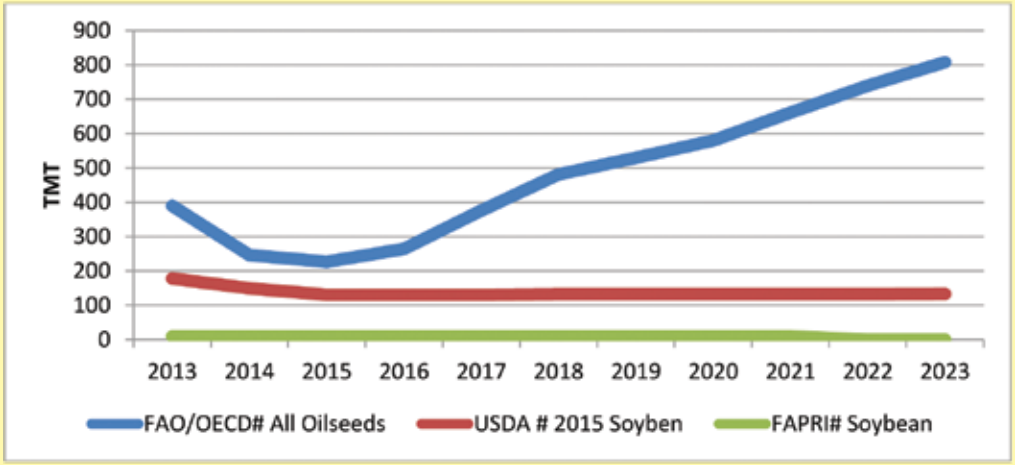


Figure 20: India Oilseed Stocks Projection

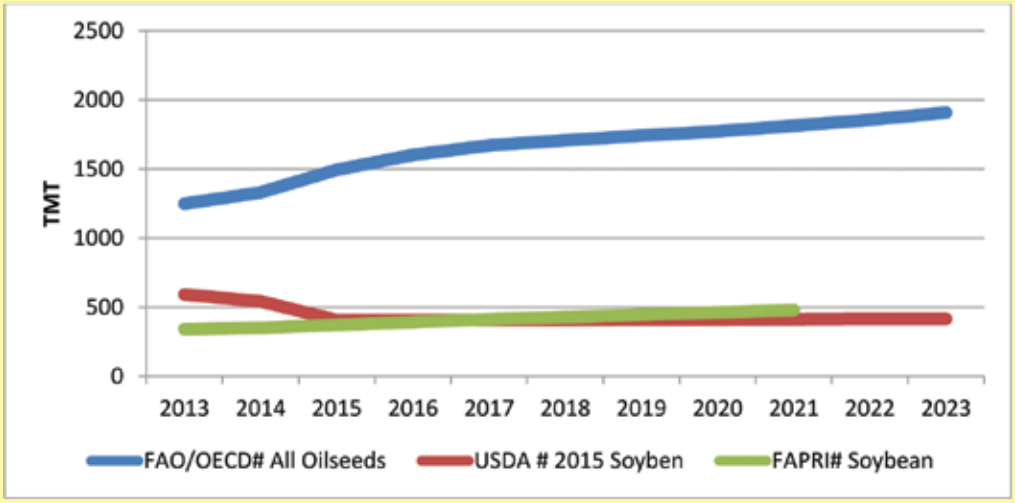


Figure 21: India Oilseed Price Projection by OECD/FAO

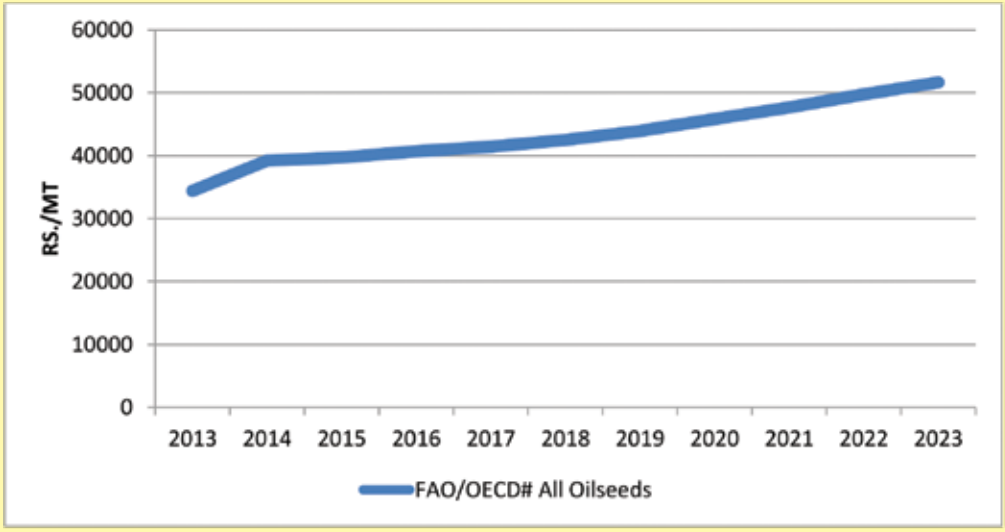


Figure 22: India Total Vegetable Oil Production by OECD/FAO

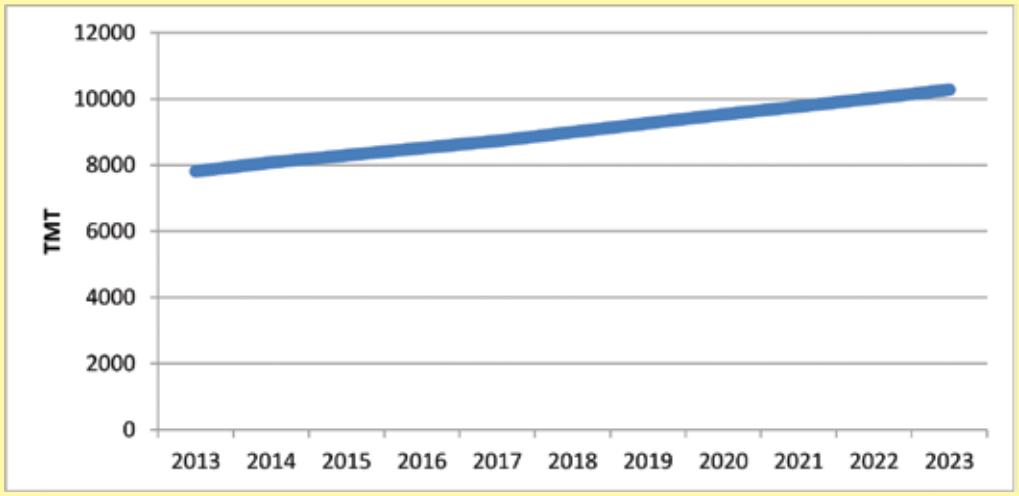


Figure 23: India Soybean Oil Production Projection

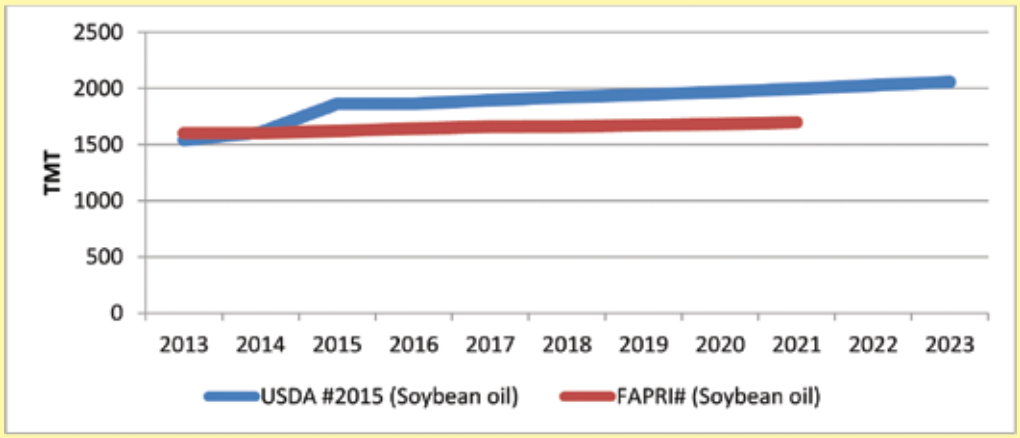


Figure 24: India Total Vegetable Oil Consumption

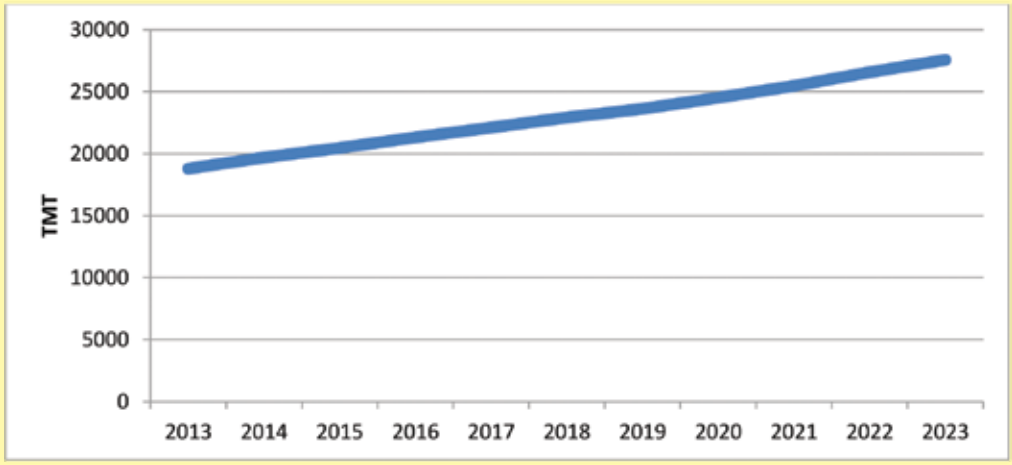


Figure 25: India Soybean Oil Consumption Projection

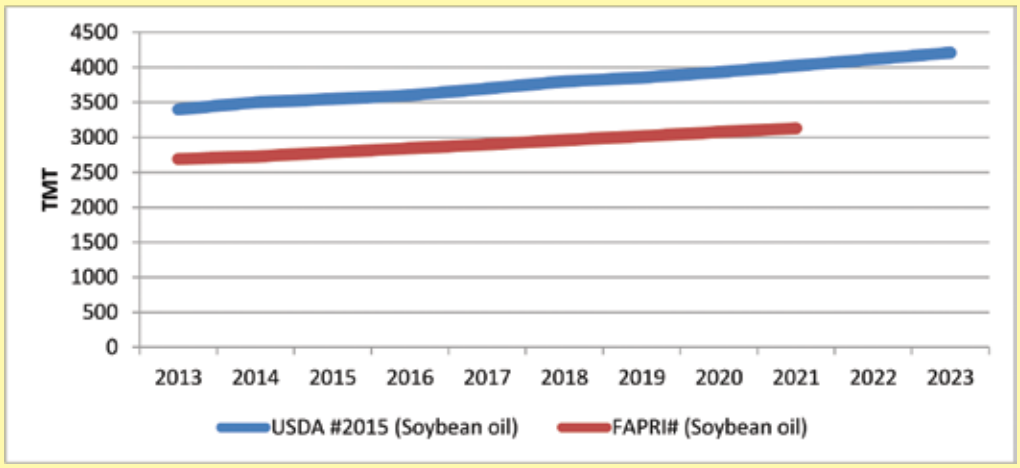


Figure 26: Per Capita Consumption of Vegetable Oils – India vs. World

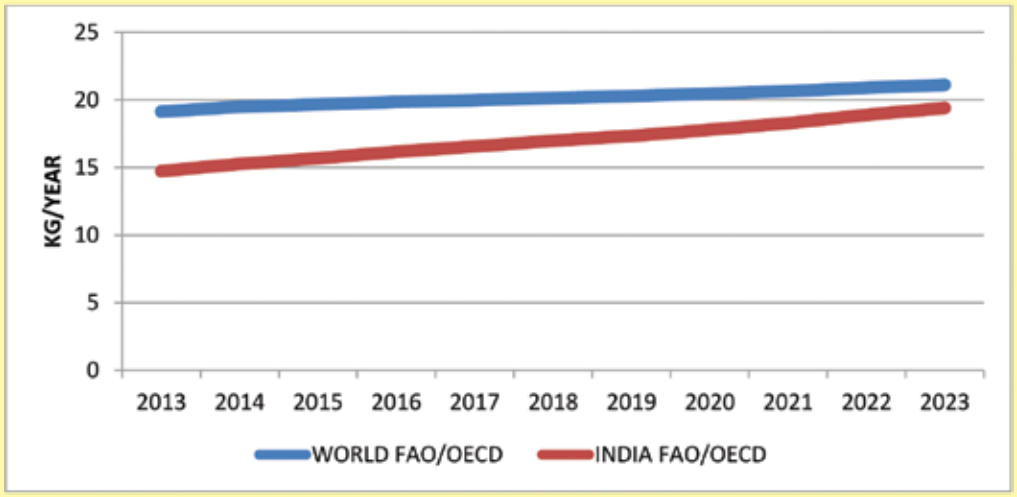


Figure 27: India Total Vegetable Oil Net Imports

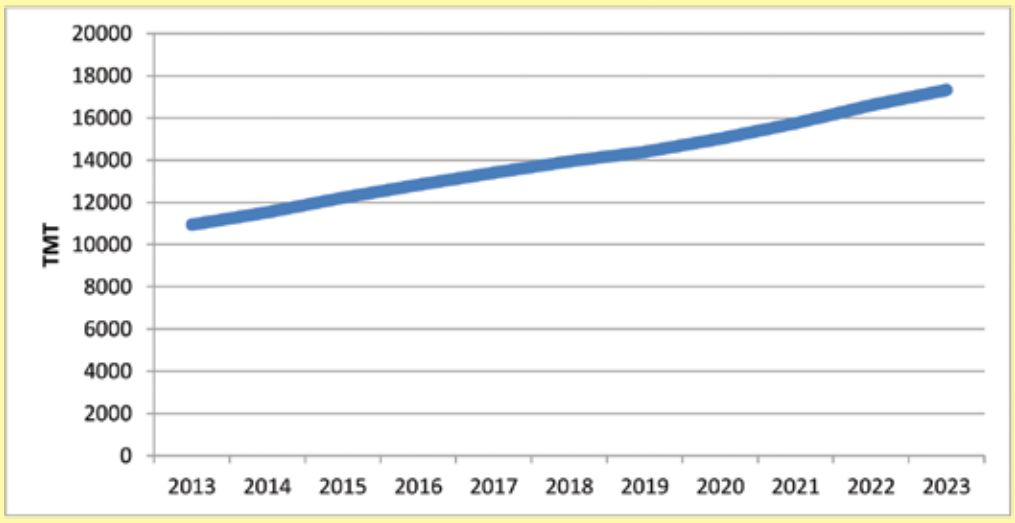


Figure 28: India Soybean Oil Imports Projection

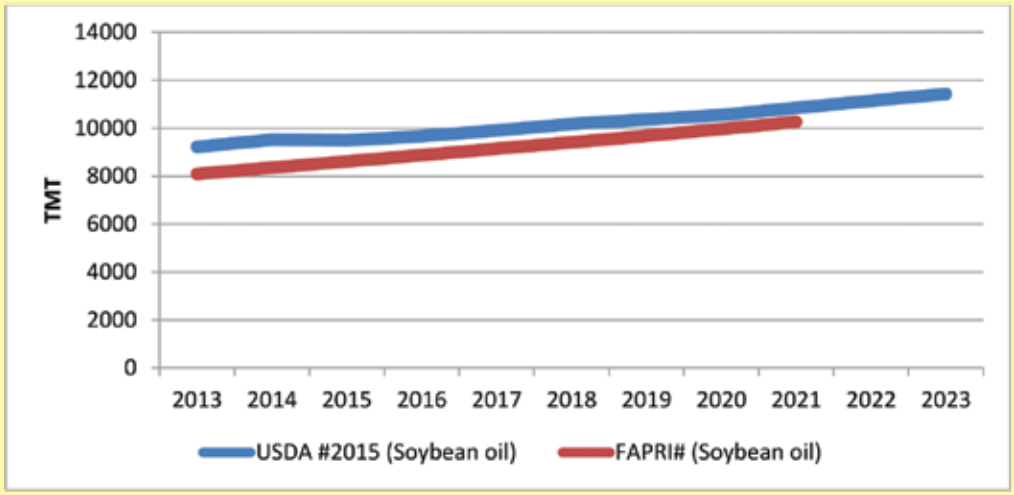


Figure 29: India Total Vegetable Oil Stocks

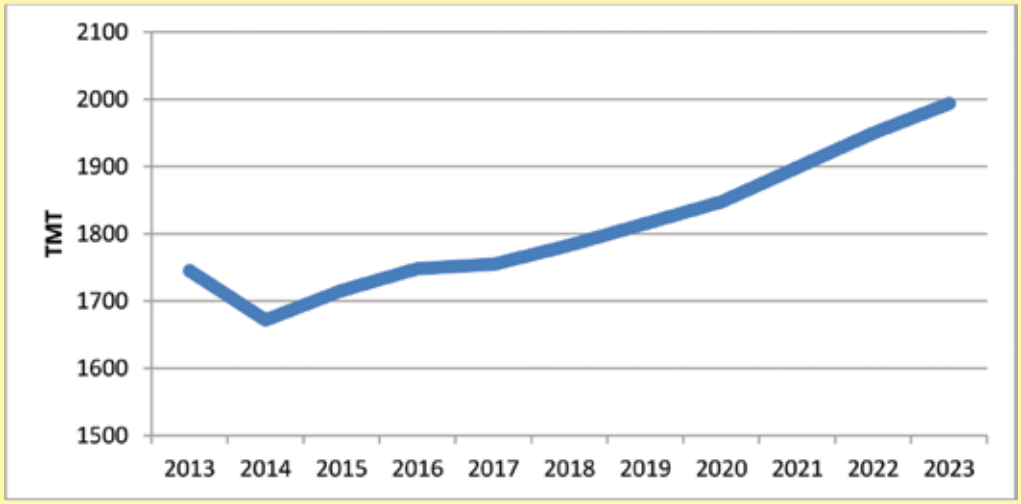


Figure 30: India Total Vegetable Oil Price Projection

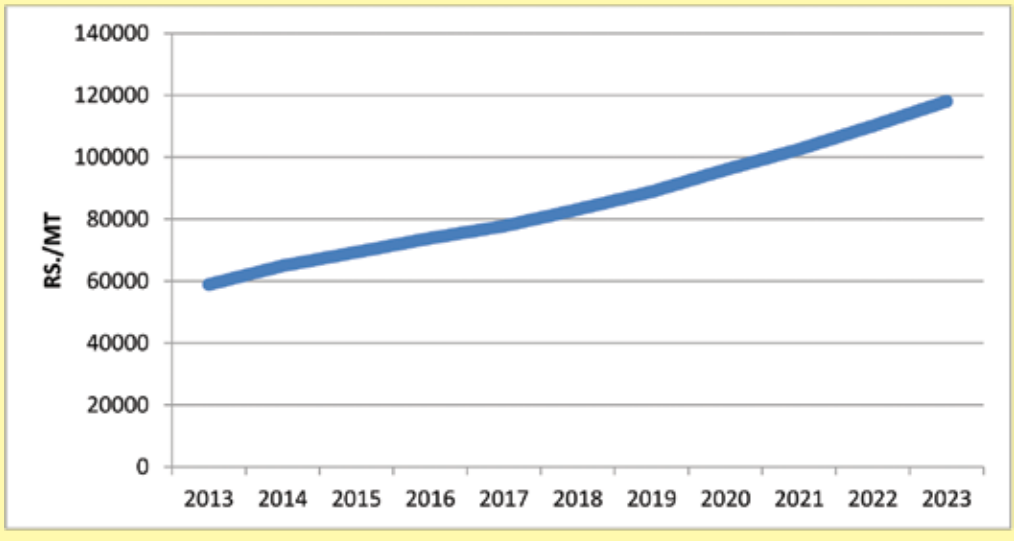


Figure 31: India Sugar Production Projection

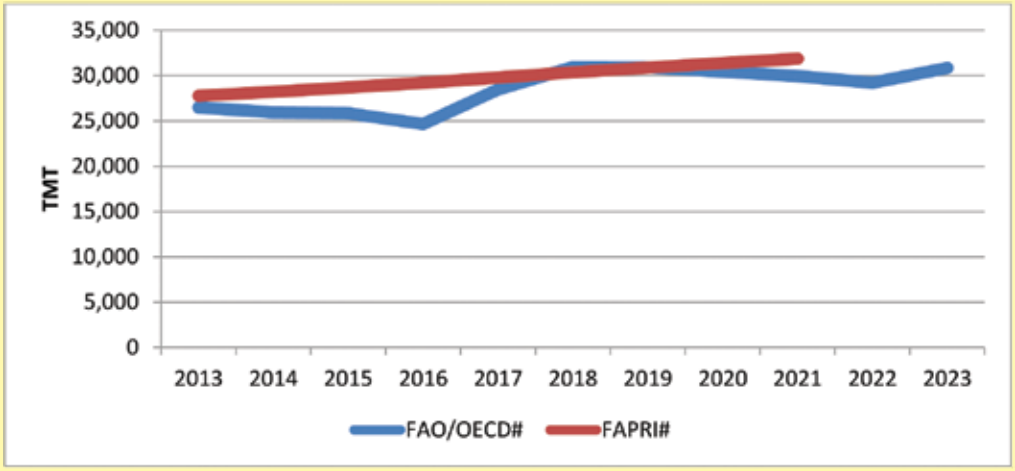


Figure 32: India Sugar Consumption Projection

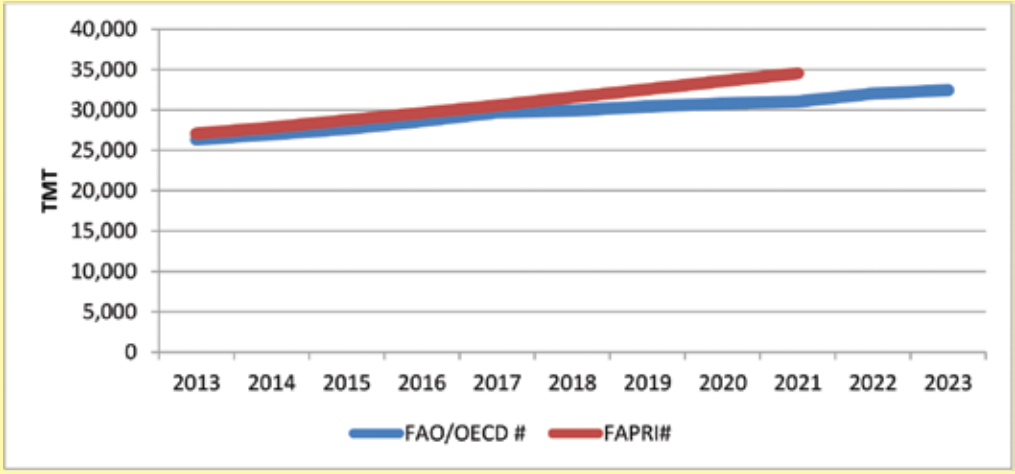
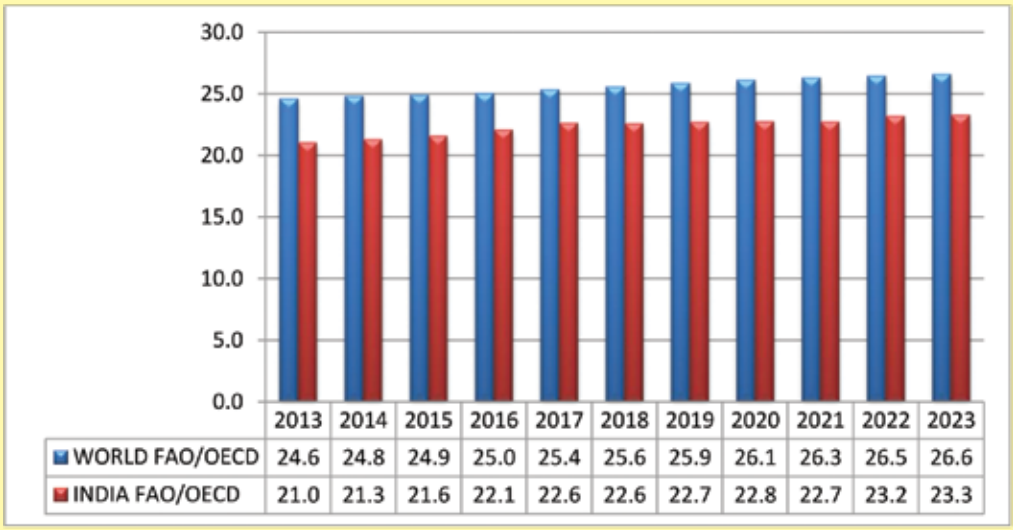
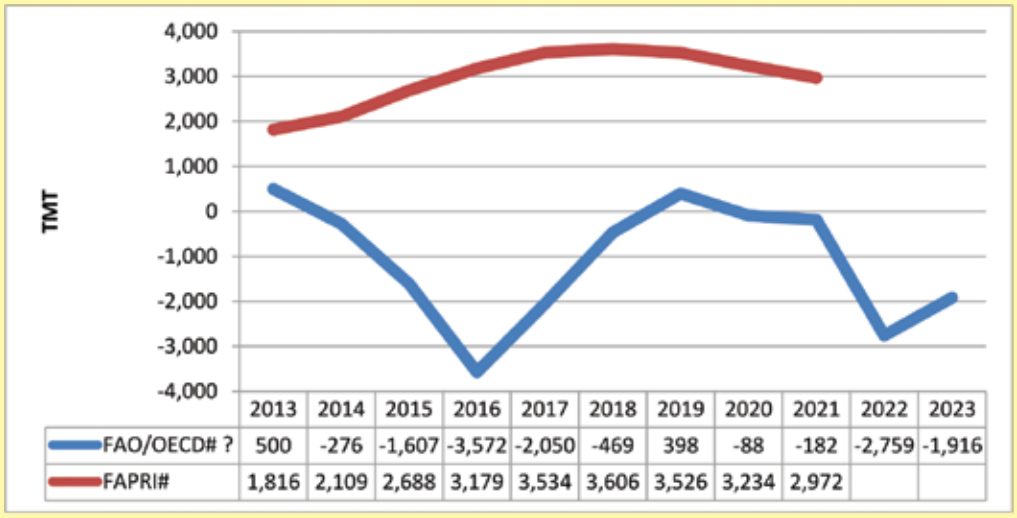


Figure 33: Per Capita Consumption of Sugar – India vs. World (Kgs/Year)



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
WORLD FAO/OECD	24.6	24.8	24.9	25.0	25.4	25.6	25.9	26.1	26.3	26.5	26.6
INDIA FAO/OECD	21.0	21.3	21.6	22.1	22.6	22.6	22.7	22.8	22.7	23.2	23.3

Figure 34: India Net Sugar Exports



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
FAO/OECD# ?	500	-276	-1,607	-3,572	-2,050	-469	398	-88	-182	-2,759	-1,916
FAPRI#	1,816	2,109	2,688	3,179	3,534	3,606	3,526	3,234	2,972		

Figure 35: India Sugar Stocks Projection

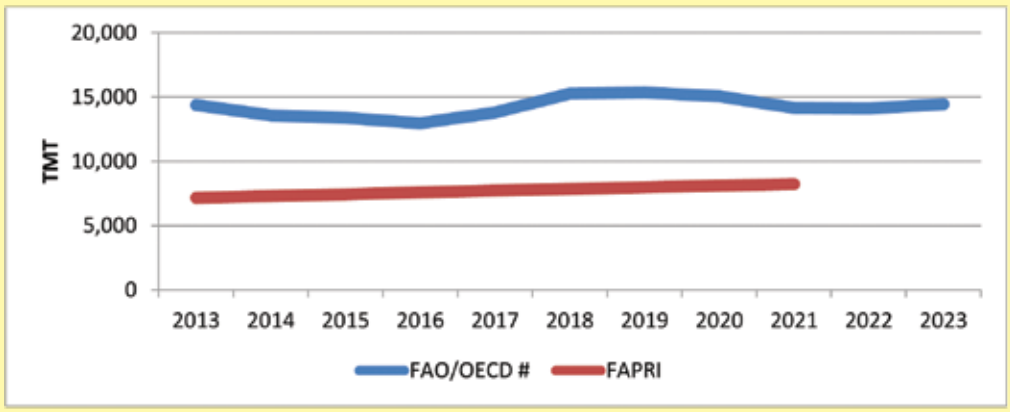
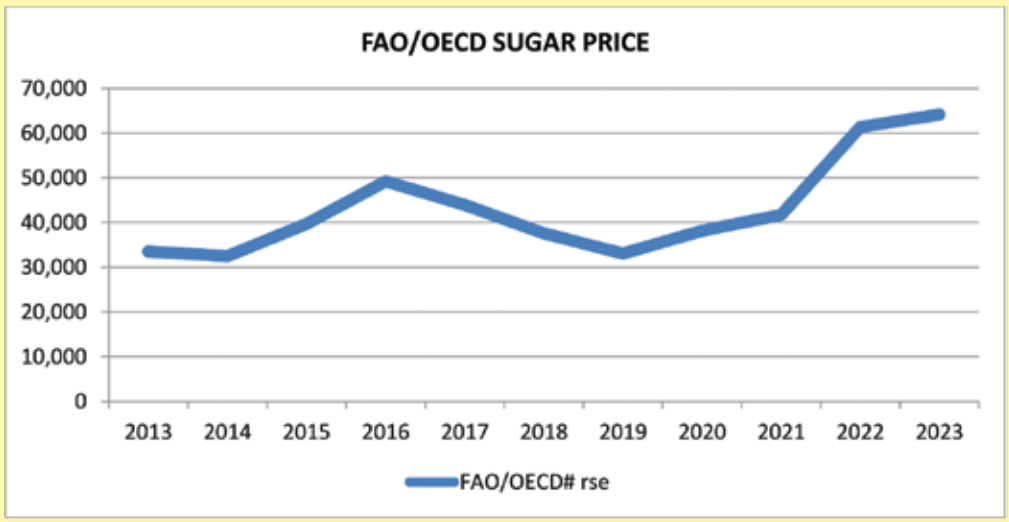


Figure 36: India Sugar Price Projection (Rs. per Tonne)



APPENDIX 2

Description of COSIMO Model and Exogenous Variables

Description of Supply Side

For any given year, we have:

1. Crop production

Cropped Area = f [{Absolute Return/ha, {Effective Payment/ha (-1)}, Cost Index} of Alternative cropping}, Area (-1), Residual Factor]

Absolute Return/ha = f {Own Producer price (Current & Previous period), Own Yield (Current & Previous period)}

Yield = f [{(Producer's Price/t (-1)}, {Effective Payment/t (-1)}, Cost index, Trend, Residual Factor]

Production = Area * Yield

2. Oilseed Production

Oilseed Meal production = Meal yield * Oilseed crush

Protein meal production = Oilseed meal + others

Oilseed oil production = Oil yield * Oilseed crush

Vegetable oil production = Oilseed oil + Palm oil + others

3. Meat production

Livestock Inventory of Pork, Poultry & Sheep = f (Quantity Produced, Trend, residual Factor)

Bovine Livestock Inventory = f [{(Producer price of Meat, Effective Payment/head) of Bovine & Milk}, Feed Expenditure Cost index, Meat & Dairy Production Cost Index, Inventory (-1), Trend, Residual Factor]

Indigenous meat production = f {Producer price of Meat, Effective Payment/t, Feed Cost Expenditure Index, Meat & Dairy Cost index, Inventory (-1), Production (-1), Trend, Residual Factor}

4. Milk production

Cow Inventory = f {Producer prices of Milk & Bovine meat/t, Effective Payment/head for Milk Cow & Bovine meat, Feed Cost Expenditure Index, Meat & Dairy Cost Index, Inventory (-1), Trend, Residual Factor}

Milk Yield = f (Milk Producer price, Effective Payment/head, Meat & Dairy Cost Index, Ruminants Feed Expenditure Cost Index, Trend, Residual Factor)

Milk production = Inventory * Yield

5. Exports

Exports = f {(Own Producer price /Export price * (1 – Tariff rate)), Residual Factor}

Export price = World Reference price * Nominal Exchange rate

Description of Demand Side

1. Food Demand

Food Consumption = f (Own Consumer price, Consumer prices of other commodities, Price deflator, Per capita Income, Population size, Trend, Residual Factor)

Note: Demand constraints apply in log linear relationship

2. Crop Feed Demand

Feed demand = f (Own Consumer price, Consumer prices of other prices, Non-ruminant production, Ruminant production, Trend, Residual Factor)

3. Crop Other Use

Other Use = f (Own Producer price, Consumer Price Index, GDP, Trend, Residual Factor)

4. Stocks

Crop Stocks = f {Stock (-1), (Own Producer price, Own Minimum Support Price, Own Food Consumption / Production), Trend, Residual Factor} Meat & Dairy Products Stocks = f {Stock (-1), Own Producer price, Production, Trend, Residual Factor)

5. Imports

Imports = f {(producer price/import price * (1 + Ad-Valorem Import Tariff)), Residual Factor}

Import price = World Reference price * Exchange rate

Producer prices are solved by using the domestic market clearing condition, which is as follows:

Production + Stocks (-1) + Imports = Consumption + Exports + Stocks

In case of Consumer prices:

Consumer price = f (Produser price, GDP Deflator, Residual Factor)

Parameters: The parameters of the model capture interrelationships among the variables. They determine the properties of the model and ensure stability of the solution. Using available estimates and given system constraints, the model is calibrated. For the rest of the parameters, estimation procedure is used with help of historical data.

Data Requirements: Annual time series for the endogenous (1983 – 2014) and exogenous variables are used (1983 – 2014 are historic and 2015 – 2024 are projected). The dataset of the endogenous variables are prepared by the historical data of prices, supply side constituents (such as, area, yield, animal numbers), demand side constituents (food, feed, crush), trade (exports and imports). Besides, the data of exogenous variables like macroeconomic variables (GDP, exchange rate, GDP deflator) and policy variables (tariff, CAP) are also put together in order to generate projections.

III.2.4: Solving the Model in TROLL: We solve the India COSIMO model in TROLL software based on data on endogenous and exogenous variables, parameterisation, and the model specification.

III.2.5: Design of the Template Code of India COSIMO Model: India COSIMO model is solved in TROLL software. The architecture of the template code is composed by the major steps, such as uploading the historical data, model creation, creating special variables, policy variables, data calculation, estimation and calibration, forecasting, simulating the model and documenting of output.

Exogenous Variable

Table: Macro Variables

Variables	Actual	Projected Figures			Actual growth rate from 2004-5 to 2014-15	Growth rate from 2015-16 to 2024-25
	2014	2015	2020	2024		
Area Harvested	146325	146041	145726	145924	0.86%	0.01%
Calories	2642	2682	2883	3018	0.45%	1.32%
Food Expenditure Index	88675	94892	220262	291987	8.72%	9.81%
Food Expenditures	37396727	20554444	32339238	45232144	10.19%	8.75%
Returns per hectare	48227	49899	63659	82012	10.79%	6.16%
Consumer price Index	1.42	1.53	2.08	2.68	8.40%	6.21%
GDP Deflator	1.33	1.42	1.87	2.34	7.01%	5.54%
GDP Index	1.24	1.32	1.82	2.34	7.05%	6.40%
Population	1267400	1282390	1353310	1406220	1.32%	1.02%
Exchange rate	62.9	64.7	76.0	86.3	3.47%	3.17%

Table: World Reference Price: USD/t

Variables	Actual	Projected Figures			Actual growth rate from 2004-5 to 2014-15	Growth rate from 2015-16 to 2024-25
	2014	2015	2020	2024		
World Coarse grains	179.60	172.00	193.00	205.00	7.87%	1.83%
World crude oil	99.64	63.80	76.72	88.10	8.93%	3.71%
World Oilseeds	436.83	405.92	434.25	461.25	6.14%	1.52%
World Poultry	2031.23	1828.86	1458.01	1548.67	11.58%	-0.75%
World Rice	434.87	385.00	415.56	440.00	7.25%	1.48%
World Root Tubers	197.13	182.38	173.81	185.54	10.86%	0.92%
World Raw sugar	327.55	351.91	359.09	380.80	6.02%	0.55%
World White Sugar	396.55	426.91	439.09	460.80	4.82%	0.51%
World Vegetable oils	788.26	704.94	812.65	863.17	4.57%	2.19%
World Wheat	290.20	240.80	250.00	265.00	5.91%	1.12%

APPENDIX 3

Core Equations of the Econometric Model Used in the Present Analysis

For supply projections, we shall use a simultaneous equation model for the historical data period from 1980–81 to 2010–11. The set of equations include four simultaneous equations to estimate the parameters for the dependent variables. These four determined variables are area, yield, farm harvest price (in real terms), and quantity of exports. Because some of the determined variables are determinants in other equations, we follow a simultaneous three stage least square (3 SLS) estimation system. The following set of simultaneous equations model have been estimated:

(i) $Y_{1t} = f(X_{11t}, X_{12t}, X_{13t}, X_{14t}, X_{15t}, X_{16t}, X_{17t}, Y_{1t-1})$

(ii) $Y_{2t} = f(X_{11t}, X_{21t}, X_{14t}, X_{15t}, X_{16t}, X_{17t}, Y_{2t-1})$

(iii) $Y_{3t} = f(X_{31t}, X_{32t}, X_{33t}, X_{34t}, X_{35t}, X_{17t}, Y_{3t-1})$

(iv) $Y_{4t} = f(X_{11t}, X_{32t}, X_{33t}, X_{41t}, X_{35t}, X_{42t}, X_{34t}, X_{43t}, X_{17t}, Y_{4t-1})$

Where

Y_{1t} is area under a particular crop (acres)
Y_{2t} is production in physical terms
Y_{3t} is real domestic price (farm harvest price)
Y_{4t} is volume of net exports
X_{11t} is real domestic (farm harvest) price
X_{12t} is real competing crop price
X_{13t} is rainfall – annual, monsoon or winter months as applicable in different cases
X_{14t} is percentage of area under irrigation
X_{15t} is fertiliser use in kg per hectare
X_{16t} is real fertiliser price
X_{17t} is time trend
X_{31t} is real minimum support price
X_{32t} is real world price or real unit value of exports
X_{33t} is production in physical terms
X_{34t} is real world income
X_{35t} is policy dummy
X_{41t} is openness in terms of share of Indian exports in the world exports commodity wise
X_{42t} is volume of world trade in a particular commodity
X_{43t} is real effective exchange rate

In addition to the four equations given above, there are the following two identities in the model:

Production = Area * Yield rate
Real farm harvest price in $ = Real farm harvest price in Rs ÷ Exchange rate

The demand projections have been obtained using the following model:

$$Q_{ijt} = q_{ij0} * P_{jt} * (1+g_{jt} * e_{ij})^t$$

where Q_{ijt} is household demand for i^{th} commodity for the j^{th} sub-group (rural or urban) during the t^{th} time period; q_{ij0} is the annual per capita quantity consumed of i^{th} commodity by the j^{th} sub group during the base year (2009-10); P_{jt} is the projected population of j^{th} sub group in the year t; g_{jt} is annual growth rate in per capita income for the j^{th} sub-group during the t^{th} time period; and e_{ij} is the expenditure elasticity of the i^{th} commodity for the j^{th} sub-group.

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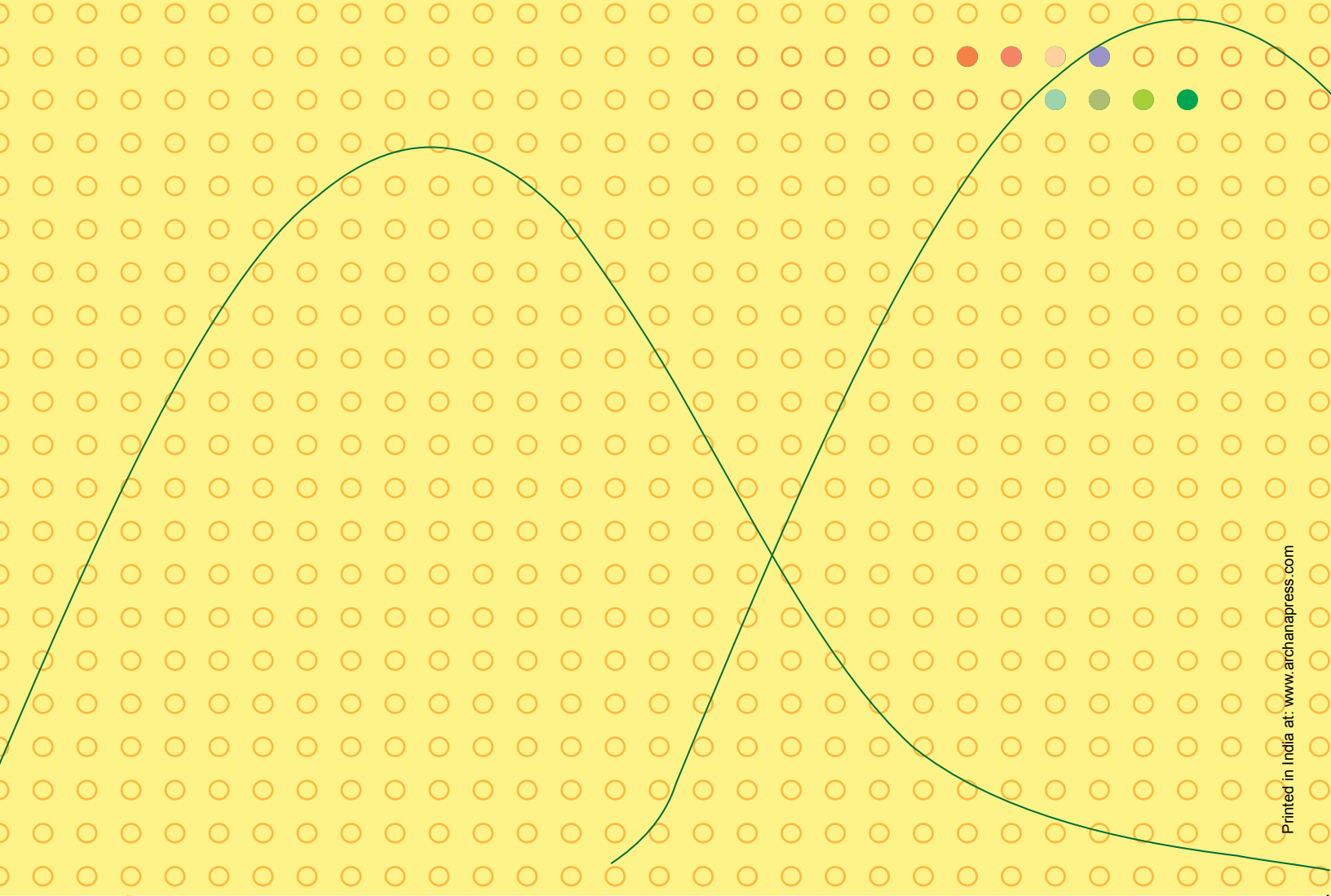

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