Project no. KBBE-212617

TAPSIM

Trade, Agricultural Policies and Structural Changes in India's Agrifood System; Implications for National and Global Markets

DRAFT VERSION

Collaborative Project

D7.1. Report on the baselines in the CGE models

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General part

Objective within the project

This deliverable discusses the baseline scenario and two scenarios with a different growth rate of Indian GDP in order to investigate the relevance of India and Indian growth for the world economy and India. The analyses are both accomplished with the national CGE of Indian and the international CGE MAGNET. The international part of the baseline simulations and scenarios is accomplished through the model MAGNET, till January 2011 called LEITAP. This model has been adapted in such a way that it is better focused on India, as discussed in TAPSIM deliverable D6.1. The construction of the baseline and adjustment to the trade side of MAGNET (specifically the use of 6 digit tariff data to calculate appropriate tariff shocks) have also been discussed in D6.1. The national part of the baseline uses the national CGE as discussed in Deliverable D6.2. The national and international CGE are to a certain extent synchronized, as discussed in Deliverable D6.3. Especially assumptions about GDP and population growth are synchronized, while for example the behaviour of capital stock is checked on consistency.

The baseline developed in this deliverable is the point of reference for the scenarios discussed in Deliverable D7.2.

Executive summary

The baseline is the point of reference for scenarios that will be discussed in deliverable D7.2. The baseline provides a projection of developments assuming that no fundamental changes will occur. The baseline projections use the modelling system as developed in Work package 6, i.e. the international Computable General Equilibrium (CGE) model MAGNET (D6.1), the national CGE model (D6.2) and a method to synchronize the two models (D6.3). The modelling system uses also information developed in work package 5, D5.1 and D5.2, on supply and demand projections, and especially the estimated equations on supply and demand.

The focus of the baselines is the period 2010-2030 for the international analysis, and the period 2010-2020 for the national analysis. Based on exogenous projections of GDP, population and factor supply, the models generate projections for consumption, production and trade split into more than 40 sectors of the Indian economy and the global economy split in its main regions. CGE modelling provides the opportunity to make projections consistent for the whole world and the whole economy, and makes interdependencies explicit.

Chapter 2 discusses the baseline with the international CGE model, including the design of the baseline, the source of population, GDP, factor supply and technology projections, and then digs into the consequences of the development of India and the world economy for consumption, production, exports, imports, direction of trade flows (with a focus on trade flows between India and the EU), land use, land productivity, employment and income. Finally some methodological issues around CGE are being discussed.

The baseline uses projections of population and GDP of USDA, but for India we have decided to set projected GDP growth between 2010 and 2030 on exactly 8% per year, which is roughly consistent with USDA projections and makes more precise what we are doing for India. Labour supply projections are based on those used in the national CGE, i.e. decreasing from 8.2% for the period 2010-2015 till 3.9% in the period 2025-2030. In calibrating technological change on GDP projections, it is assumed that labour productivity in agriculture grows 1.3 times as fast as in services, while it grows 2.6 as fast in industry. For each sector land productivity grows 0.1 times labour productivity plus the exogenous FAO projections, while intermediate demand productivity grows with 0.1 times labour productivity.

Demand in the model is driven by a standard GTAP CDE (constant difference of elasticity) function that is extended with income elasticities depending on purchasing power parity (PPP) corrected GDP per capita. Price and income elasticities for agriculture in India are adjusted consistent with the results of the estimates in TAPSIM deliverable 5.1.

Because GDP growth per capita in India is much faster than the average in the world, the faster technological change in industry generates a comparative advantage for Indian manufacturing industry. This stimulates Indian exports and in combination of a shift in demand from agriculture to industry the volume of production rises faster in industry than in other sectors of the economy. Despite this fact, employment grows faster in services than in industry because labour saving technological change is much slower in services than in industry.

Agriculture has its specific problems because the availability of land and water in India is limited and Indian population and GDP are growing very fast. As a consequence, increasing agricultural production is costly. The prices of crops rise about 14% more in India than in the rest of the world, and that this is not more is caused by the excess of rural labour supply that keeps wages low in agricultural areas in India. The price of arable land in India rises with

600% between 2010 and 2030, compared with 200% in the rest of the world. That the rising cost in India doesn't generate much more agricultural imports is because Indian trade is limited in the database for the model, and this is consistent with current Indian policies.

With respect to consumption, private consumption of crops per capita in India rises between 2010 and 2030 with about 10%, compared with 7% in the world. The growth is completely in high value added crops like vegetables and fruits and not in cereals. For livestock products per capita consumption growth is 24% compared with 13% in the world. There is also a tendency towards consumption of more processed food: consumption in India rises with about 21% against 8% in the rest of the world. This is a characteristic of a maturing economy.

With respect to trade we see that consistent with the increasing land scarcity in India agricultural imports increase fast, while agricultural exports remain more or less the same. Nevertheless net imports as percentage of the production value are still small in 2030; less than 2% for crops and less than 1% for livestock. So, in the baseline projections India remains relatively self-sufficient. This is consistent with the supply and demand projections accomplished in Work package 5.

With respect to processed agricultural products both imports and exports rise more or less with production, keeping net exports as fraction of production at about 4%, as it is now. The big changes are in industry and services, where for industry net imports of 4% of production value in 2010 change into net exports of 2% of production, and for services a net export of 1.5% of production value changes into a net import of 1% of production value. This is consistent with the generation of comparative advantages in industry, as discussed before. The change in net exports in industry and services is mainly caused by changes in exports, while imports as fraction of production value remain more or less the same.

In 2010 most Indian exports go to the EU27 and NAFTA. In 2030 the share of these regions is reduced to the benefit of North Africa and Middle East, and China. This tendency is explained by differences in income growth, and changes in the specialisation pattern of India towards industrial commodities. With respect to agricultural exports Africa and Middle East rise in importance with its share rising from 30% to 52% as a consequence of fast growth in demand of agricultural commodities in these regions. This is a logical development: in regions where population and income growth is fast and starts at a low level, demand for agricultural products rises fast, while in the richer regions and regions with less population growth, like the EU, demand for agricultural products rises only a little bit. With respect to imports to change in the market share of partner regions is much less.

Although the Indian imports as fraction of production value don't change much, it still means for the EU a large increase in export opportunities. While exports to the rest of the world rise with 56%, exports to India rise with 180%. And production volume in the EU rises with only 40%. These impressive changes in exports are put into context if we are aware that the rise in exports to India as percentage of EU production is only from 0.2% to 0.47%, so still remains very small.

In summary, the baseline shows the increasing importance of industry in Indian production and exports, while the share of primary agricultural commodities in trade and production is reduced. Not only is the latter constrained by land and water availability, industry benefits from relatively high rates of technological progress. Another part of the explanation lies in changing Indian demand patterns, shifting away from food towards expenditures on manufactured goods and services. The agricultural sectors however still grow, but given preference shifts and developments in comparative advantages especially the sheep, goats and chicken, wheat and milk sectors benefit. With respect to trade relations, in terms agricultural and overall trade, the EU's importance for India falls, with the exception of agricultural imports, where the EU's importance as a source region rises slightly. Increased demand for

land leads to intensification in land use, which ensures that India is able to grow fast without becoming too dependent on the world market for food. The consequences of the development of India for incomes depends to a large extent on the possibility to increase mobility of labour from rural to urban areas and from agriculture to industry and services.

Chapter 3 focuses on a special topic, i.e. the effect of faster or slower Indian GDP growth on the Indian economy and the rest of the world. For the baseline an average GDP growth of India of 8% per year was assumed. What would be the consequence of slower growth (i.e. 6% per year) or faster growth (10% per year)? The analysis is made for the same indicators as in the baseline.

Faster growth of India implies a faster transition towards a modern society. Consumption patterns change away from food towards industrial commodities and services, as does production. Because technological development is faster in industry than in services, there is a tendency of the service share in national income to increase. Related to the fast technological change in industry, India becomes a more important net exporter of industrial commodities , and a net importer of services. With respect to agriculture, the restrictions on land and water availability, in combination with a rise in demand for foods, imply that the net imports of crops increase much more. The EU27 and Africa region benefit relatively more from rising agricultural imports by India than other regions. The rise in imports is, however, not enough to satisfy rising Indian demand for food so that the pressure on land increases, resulting in fast rising land and crop (and livestock) prices, much more so than in the rest of the world. Rising land prices lead to an intensification in the use of land. In the future, rising domestic land and food prices may necessitate a more flexible import policy, agricultural investments to enable higher land productivity and, more generally, technical progress in agriculture. This may soften the impacts that a faster Indian growth has on resource scarcity, lowering food prices faced by households and increasing their consumption of food.

Chapter 4 uses the national CGE model of India to go into more depth on the internal effects of the baseline and the different growth scenarios. The assumptions on population growth, GDP growth and factor supply have been made consistent between the two models. In this chapter projections are also compared with other projections on the Indian economy with a focus on agriculture. The focus of the analysis is on the consequences of Indian growth for the distribution between rural and urban income levels, and the distribution between income classes within the rural and urban areas.

We may conclude that 10% GDP growth does not favour rural income due to a dip in agriculture growth. Rural share has come down from 61% to 56% with GDP growth moving up from 8% to 10% . In 2019-20, even though 10% growth seems to benefit industry and services, it is not really benefitting rural industries. This is caused by the assumption in the model that labour force in rural areas does not depend on growth. If we analyse by income groups, then 10% growth is mostly benefitting urban high income groups. This confirms that the growth is not trickling down. In particular rural bottom 2 groups' real income growth has been reduced with GDP growth increasing from 8% to 10% in the period 2010-20. This is also reflected in the real income per capita figures.

A major policy implication drawn from the study is 'how to improve agriculture in the higher GDP growth scenario?'. Also supplementary measures are needed to tackle dipping rural poor income with increasing growth. One of the important issues in this respect may be the mobility between rural and urban areas. If rural population will be allowed to move to urban areas, labour scarcity in urban areas will be reduced while labour scarcity in rural areas will be increased, improving the balance between income development over the country.

With these baseline analyses an insight has been provided on the dynamics of the Indian economy for India, the EU and the rest of the world.

Scientific and societal relevance

Getting an insight in the dynamics of the Indian economy in an international context is of fundamental importance for understanding the future of the world. With these baselines these insights are improved. The logic of the CGE models help to understand the logical relations between different aspects of Indian growth and trade. By integrating the international context, comparative advantages, and supply and demand of all commodities and production factors in an integrated whole projections of supply, demand and trade get more depth, while the partial equilibrium analysis accomplished in Work Package 5 gives empirical inputs to enrich the general equilibrium analysis for agricultural details.

By separating out the effect of Indian growth on India and the rest of the world, the importance of Indian growth has been illuminated. By also analysing income distribution aspects in the national CGE model, the picture of growth and poverty has been enriched.

Specific part

1 Introduction

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With these baseline analyses an insight is provided on the dynamics of the Indian economy for India, the EU and the rest of the world.

2 Baseline of the international model

2.1 Introduction

This chapter discusses the baseline of India and the rest of the world economy with the international CGE model. After a short discussion of the design of such a baseline (section 2.2) and the role of the basic assumptions in such a baseline (section 2.3), developments of India in its relationship with the rest of the world will be discussed (section 2.4), comparing the results with outcomes of other projection studies. The focus of the discussion of the baseline is an attempt to understand the fundamental causes behind the developments that are generated by the model. In order to put the description of this baseline into perspective, some methodological issues will be discussed shortly (section 2.5), after which the most important points are summarized (section 2.6).

2.2 Design of the baseline

The design of the baseline with the international CGE has been discussed in deliverable 6.1. For this reason, we will keep it short here. The basic features are as follows. First, the USDA projections of population in different regions in the world is used to determine exogenous population and labour supply growth in all regions of the world except for India. For India the international CGE uses the same projections as used in the national CGE model. For the period 2010-2015 Indian labor supply grows with 8.2%, and for the period 2015-2020 with 6.5%. Then it decreases till 4.7% for 2020-2025 and 3.9% for 2025-2030. Second, technological change is calibrated on GDP projections as supplied by USDA. Again, the exception is India, where an 8% GDP growth per year is used for the whole period 2010-2030.

The rate of technological progress differs between sectors and inputs. Technological change in primary agriculture is1.3 times as fast as in services, and productivity in industry grows 2.6 times as fast. This is consistent with more pessimistic views about the future of agricultural productivity as represented by predictions of stable or even rising real agricultural prices in the future. The technology is assumed to be mainly labour saving, with land productivity growing consistent with FAO projections plus 10% of the increase in labour productivity ($1/3^{rd}$ of what was discussed in deliverable 6.1). Capital productivity is assumed to grow with about $1/7^{th}$ of labour productivity, natural resource productivity grows with 30% of labour productivity growth, while technological change for intermediate inputs is set at 10% of labour productivity growth.

Consumption is determined by the standard GTAP CDE consumption function extended with dynamic income elasticities that depend on purchasing power parity (PPP) corrected GDP per capita. The formula determining these income elasticities has been estimated on the implicit price elasticities used in the GTAP database, but these have been decreased for agricultural products in an ad hoc manner based on information from FAO and plausibility with respect to developments in calorie intake of food. Based on the study of income elasticities in deliverable 5.1 the function is shifted for agricultural commodities in such a manner that it is consistent with the estimates in 2010 for India. The CDE consumption function is calibrated continuously on the income elasticities as determined by PPP corrected GDP per capita and exogenous price elasticities of consumption. The price elasticities of consumption are based on the ones in the GTAP database for all regions except for India. For India the price

elasticities of consumption for agricultural commodities are adjusted towards the estimates derived in deliverable 5.1.

For the simulations we use the version with international capital dynamics, making investment endogenous. For this reason, no exogenous projections for growth of capital stock are required.

In summary, the baseline is derived from standard assumptions on population and GDP growth, FAO land productivity projections, a consumption function using dynamic income elasticities and specific assumptions for India for most projections, including GDP, labour supply, income and price elasticities of consumption.

2.3 Population, GDP and technology

Population growth, growth in production factor supply, and technical change are very important driving forces of the world economy. GDP growth is one of the results of these processes, and is used to calibrate technology in the model. Differences in technological development drive changes in comparative advantages, and therefore is crucial in explaining patterns of growth and trade. In this section we describe the general pattern of these driving forces.

First, let us have a look at population growth. Figure 2.1 shows that Indian population is growing slightly faster than the world average, while the rest of Southern Asia and especially Africa grow much faster. China, the former Soviet Union and the EU27 have almost zero population growth. Population of NAFTA, Oceania and southern America grow only a little bit less than in India.

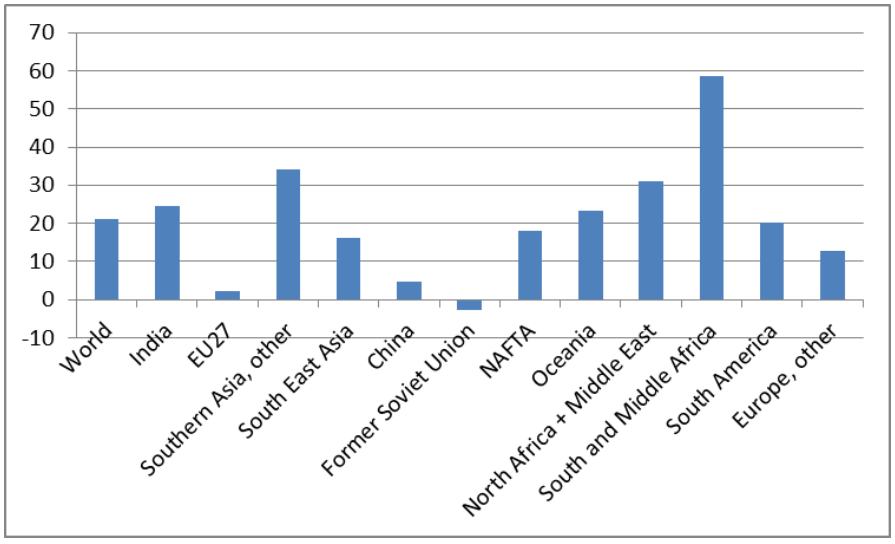


Figure 2-1 Population growth 2010-2030 (%)

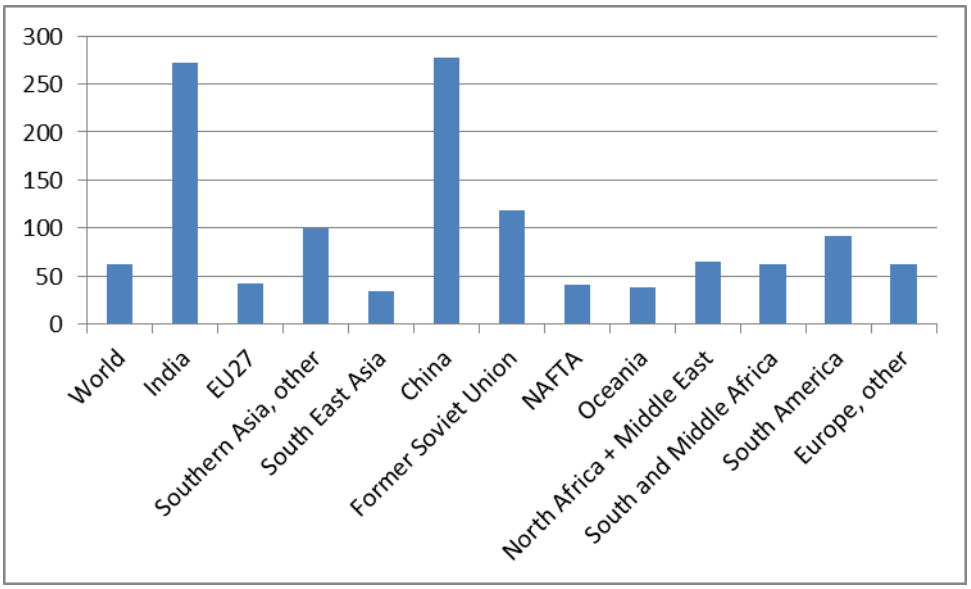


Figure 2-2 GDP per capita growth 2010-2030 (%)

With respect to increases in GDP the picture is completely different. While globally the average GDP per capita (figure 2.2) grows with only 50% in 20 years, GDP per capita in India and China grows with 250%. The richer regions, i.e. EU27, South East Asia, NAFTA and Oceania grow with less than the world average, while it is assumed that African GDP per capita is not growing much more than the world average, partly as a consequence of their fast population growth, and partly because political and societal turmoil which impedes the transition towards more efficient economies.

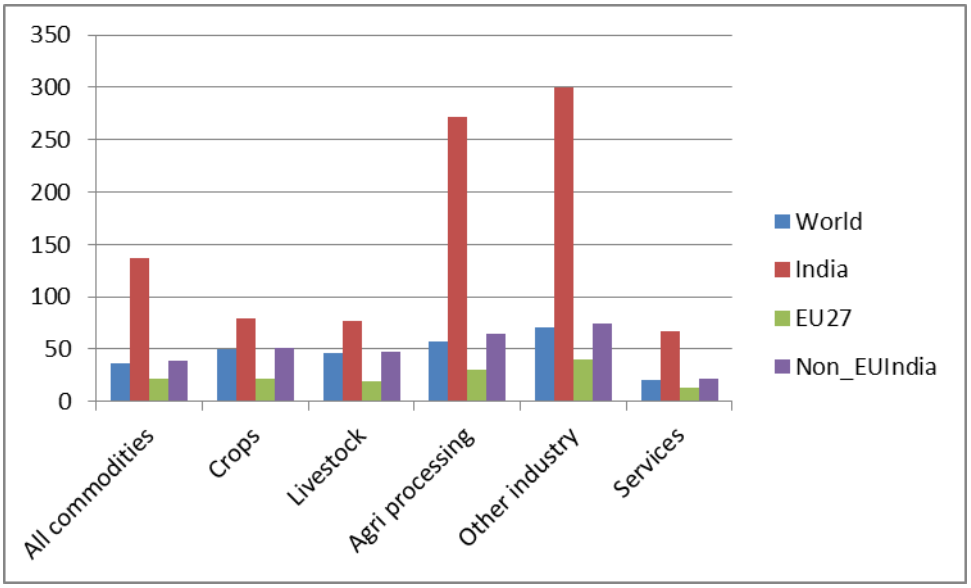


Figure 2-3 Total factor productivity growth 2010-2030

If we look at the consequences of the GDP calibration for technological change for different sectors, we see in figure 2.3 that technological change in the Indian economy is much faster than the average in the rest of the world, but that the difference is especially large in the manufacturing industry excluding agri-processing. For comparative advantages not only total factor productivity is relevant, but also the share of value added in total output value and intermediate technological change. Figure 2.4 shows the productivity increase on all inputs.

The difference in growth of the productivity of all inputs in manufacturing industry with agriculture and services is much less than that measured in terms of total factor productivity because the share of value added in total output value in industry is less than in agriculture and services.

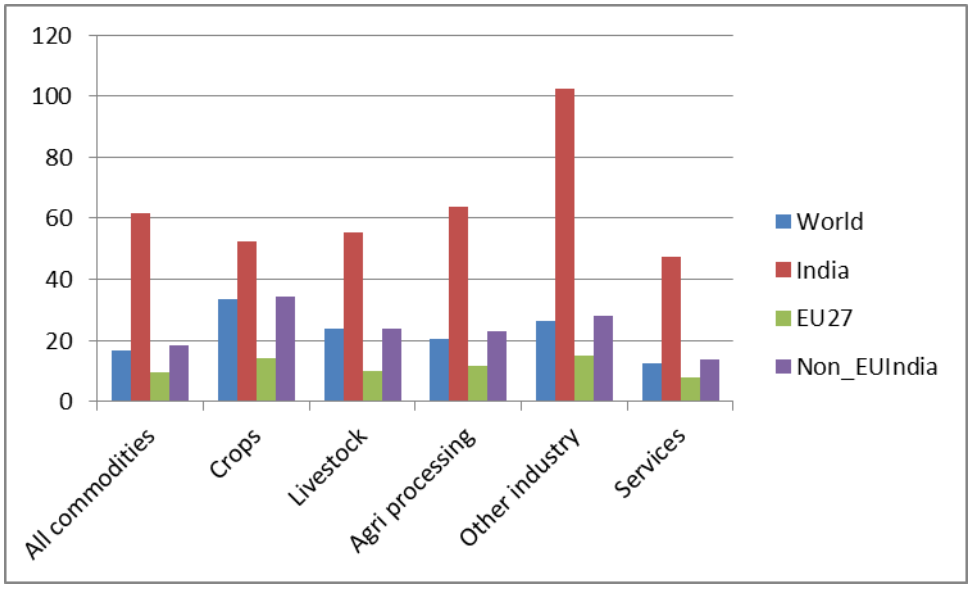


Figure 2-4 Technological change per sector on all inputs, 2010-2030

The impact of productivity changes on prices is shown in figure 2.5. All prices are scaled in such a manner that the price level of world GDP remains stable. Because of the relatively fast growth of technology in India and China, the overall price level in these countries will decline. In general, crops tend to however increase in price because of increasing scarcity of land, and this effect is strongest in India and China. This increase in scarcity of land stems from a combination of population growth, rising per capita incomes, urbanisation and a rising middle class which will boost demand for food (conform the study by Binswanger-Mkhize et al., 2012). Industrial commodities, on the other hand, are becoming relatively cheap in India, while also services in India decline in price.

The changes in the Indian economy over time are in line with structural changes undergone by the industrialised world, prior to rapid economic growth and structural transformation (Binswanger-Mkhize, 2012). This can be characterised by industry being more productive and growing faster, thereby withdrawing labour from agriculture until convergence (in terms of labour productivity and wages) is reached.

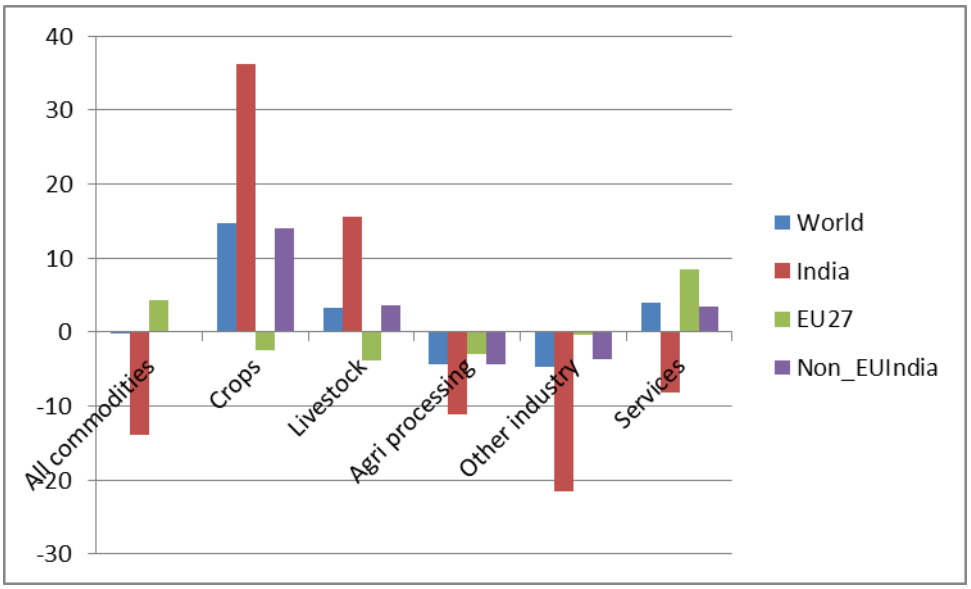


Figure 2-5 Price change per sector 2010-2030

In sum, population and technology explain patterns of growth in different regions in the world. India benefits from comparative advantages in industry because of the trend generally observed over time that in an economy with fast technological change, most of this growth stems from the industrial sector. Scarcity of land makes agricultural commodities relatively expensive.

2.4 Sector developments in India, the EU and the rest of the world

2.4.1 Introduction

Section 2.3 gave a sketch of the main assumptions regarding population, GDP and technology factors which underlie the baseline scenario. Here we look into what the baseline looks like, focussing on consumption, production, trade, land use and employment. Where possible we will draw comparisons with other projection studies, including Alexandratos and Bruinsma (2012), Binswanger-Mkhize (2012) and Binswanger-Mkhize et al. (2012).

2.4.2 Consumption

When welfare increases, the pattern of consumption changes. If we divide expenditures in expenditures on food, industry and services, then the share of food expenditures decreases from 30% in 2010 to 15% in 2030 to the benefit of expenditures on services (figure 2.6). The declining share for food is in line with Engel's law which states that as income rises the proportion of this income spent on food will fall.

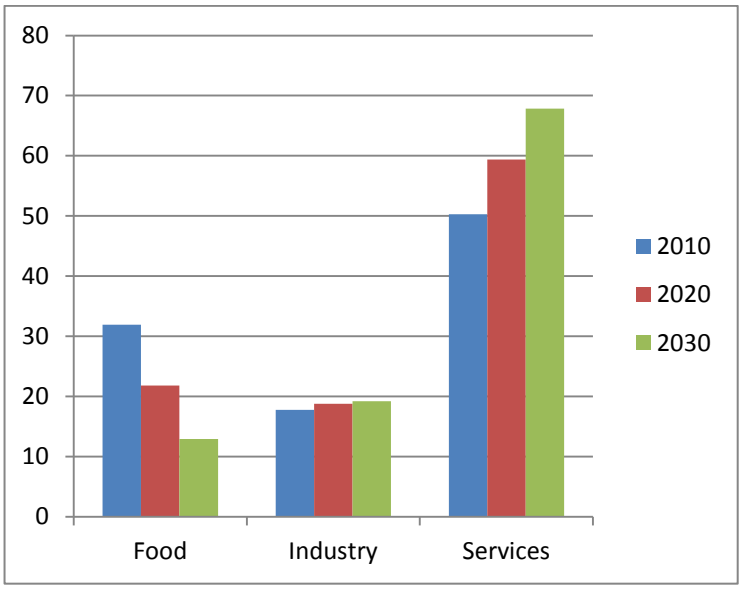


Figure 2-6 % Shares in total consumption expenditures India

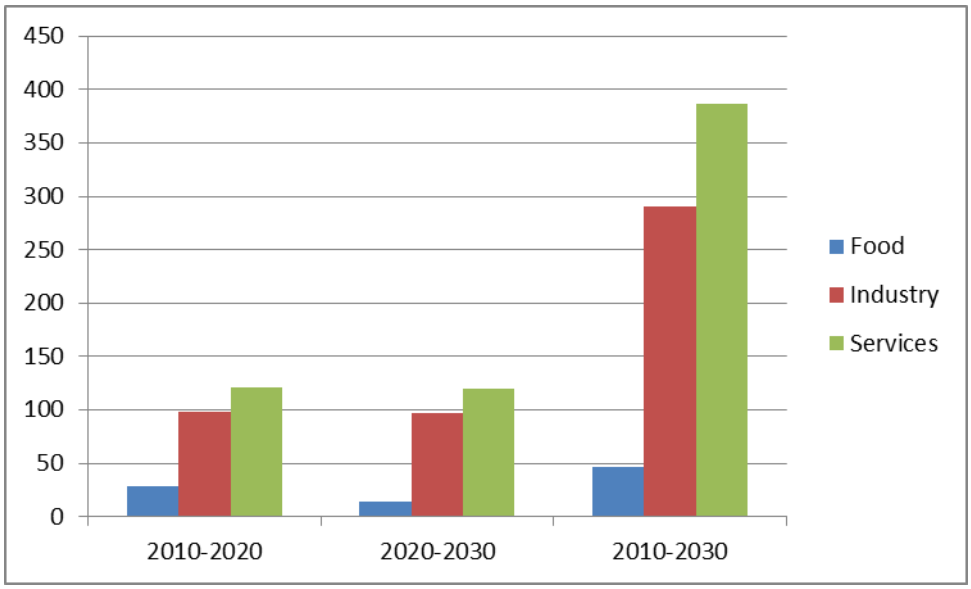


Figure 2-7 Growth (%) of consumption volume India

Behind this picture is a combination of changes in volume and prices. The volume of demand for industrial commodities rises with almost the same rate as the volume of demand for services (figure 2.7), but because the price of service commodities rises faster, the share of services increases while the share of industry remains the same.

The projected relatively slow growth for food demand is in line with Alexandratos and Bruinsma (2012) which finds that food demand measured in calories in India has not been growing near the rates one would expect from the high economic growth and large and unsatisfied food needs. Reasons include changes in real relative prices (in our model, prices for crops and livestock rise a lot), shifts in consumption towards more high-value goods (such as milk, vegetables, poultry) which has also been incorporated in our model, but also changes in household age composition, food habits, reduced physical activity levels and improved health environment. Furthermore according to the latter study, our projections are in line with other OECD-FAO and FAPRI projections in that, in contrast to national sources, there are

marginal increases in food consumption rather than declines. They imply that caloric intake would also be increasing.

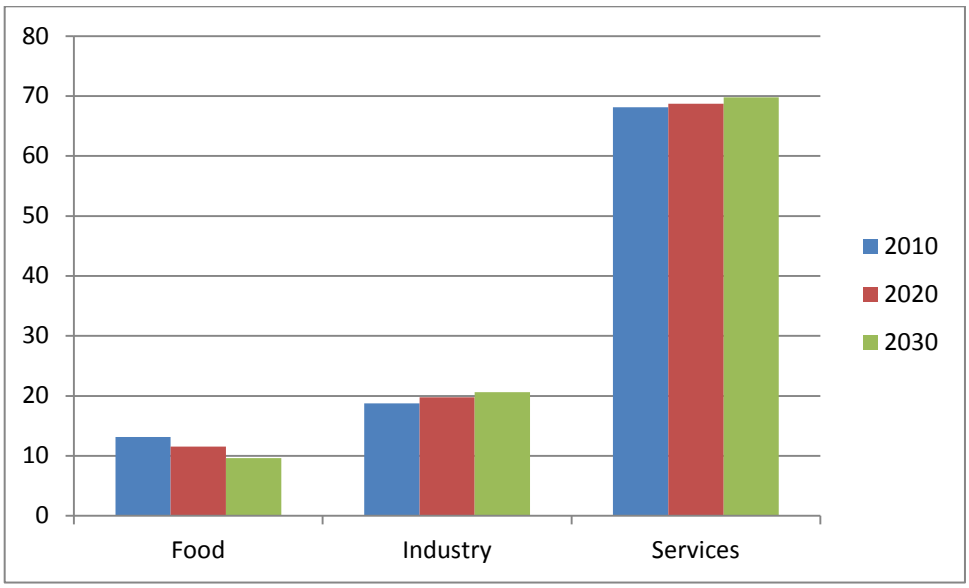


Figure 2-8 % Sector share in consumption expenditures for the world

It is difficult and not very useful to give more detail on consumption expenditures in a general equilibrium model with a lot of intermediate deliveries of agricultural sectors to processing food industries and very aggregated sectors. For example, although direct consumption of wheat is visible in private consumption, there is a lot of indirect consumption of wheat, for example in the form of bread, that is included in a very large "other feed and food" sector. For this reason we will do not give more detail on private consumption and focus on production and trade. Consumption patterns have been modelled in line with dietary changes that are generally visible over time using national estimates of income and price elasticities for India (see TAPSIM Deliverable 6.1). It is important to note here that due to India's strong vegetarian tradition and religious cultures against consumption of beef and pork, dietary shifts are likely to be less strong than those that have been observed in the rest of the world, and notably China, and if they occur more towards milk and poultry (Alexandratos and Bruinsma, 2012).

2.4.3 Production

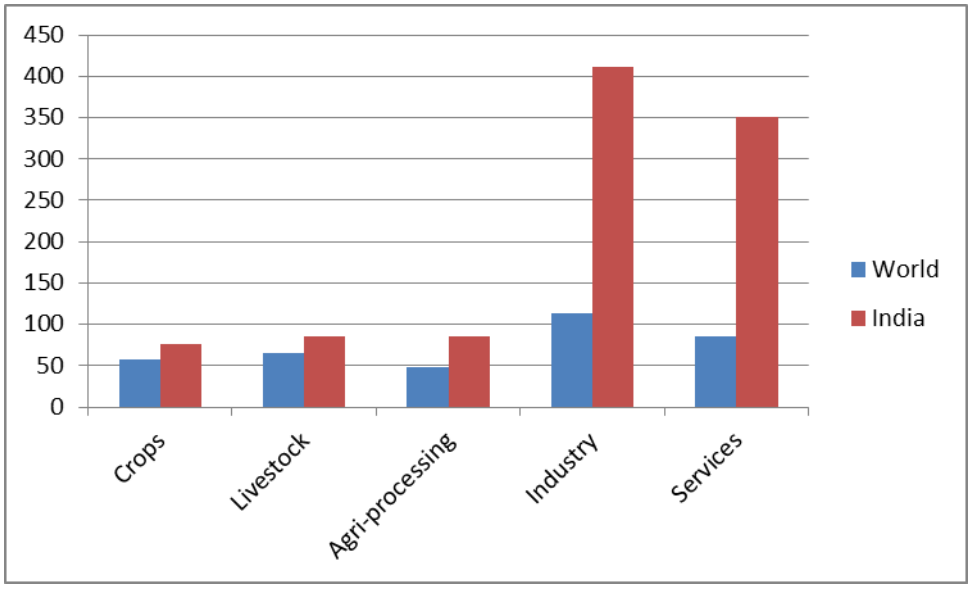


Figure 2-9 Production volume growth 2010-2030 (%)

Figure 2.9 shows that with a growth of 400% in 20 years, the industrial sector is the fastest growing sector, followed by services. Crops, livestock and agri-processing grow only with 40% to 80% in 20 years. Compared with the world average the growth of primary agriculture is only slightly higher than in the rest of the world, while for the agri-processing industry it is almost double the world average; this shows the tendency of a developing economy towards more agri-processing (and industry, and to a lesser extent services). The background of these processes can be explained by a relatively high demand for processed and industrial products and technological change which is faster in industry than in agriculture, generating comparative advantages for industrial commodities.

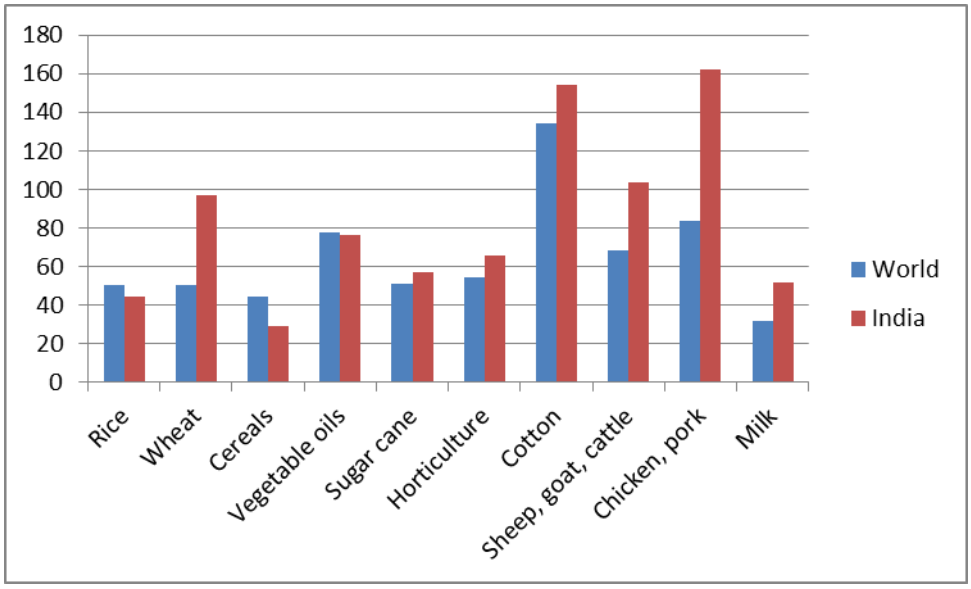


Figure 2-10 Growth of agricultural production volume 2010-2030 (%)

If we split the agricultural commodities (figure 2.10), we see that especially cotton (for the rest of the world including also other plant-based fibres) grows very fast, as does the

production of sheep and goats, respectively chicken, wheat and to a lesser extent milk. This can be explained by both growth in demand for these commodities, and the possibilities to export these commodities given developments in comparative advantages.

2.4.4 Exports, imports and net exports

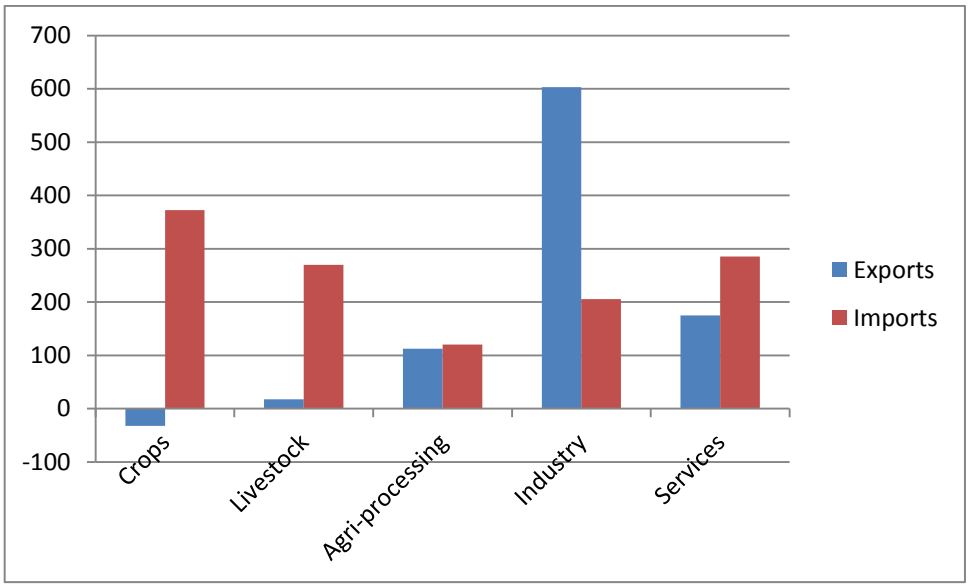


Figure 2-11 Indian export and import growth 2010-2030 (%)

Consistent with the development of Indian relative prices compared with the rest of the world, India generates comparative advantages in the export of industrial products, while exports of primary agricultural commodities decline (figure 2.11). Exports of industrial commodities grow much faster than production, while imports grow much less, implying that Indian industry competes very well both on the domestic and international markets. Consistent with this picture is an increase in imports of primary agricultural commodities, creating a net import of crops of almost 3% of production in 2030 (figure 2.12-2.14).

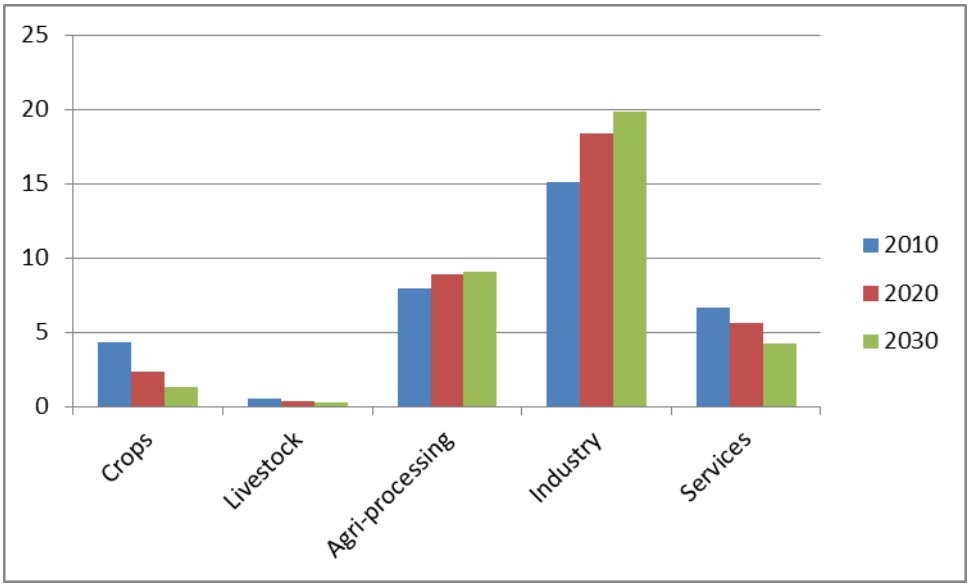


Figure 2-12 Indian exports as percentage of production value

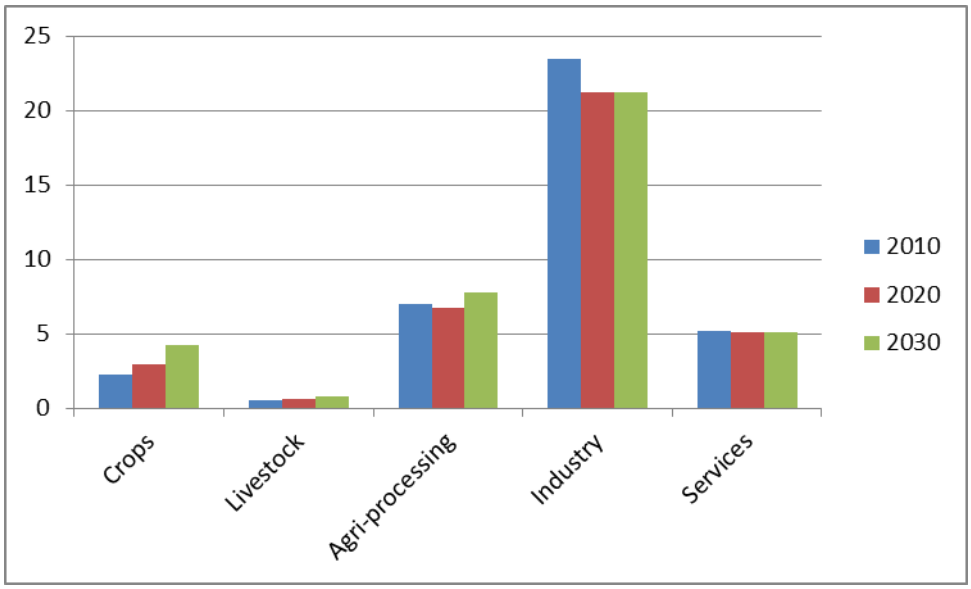


Figure 2-13 Indian imports as percentage of production value

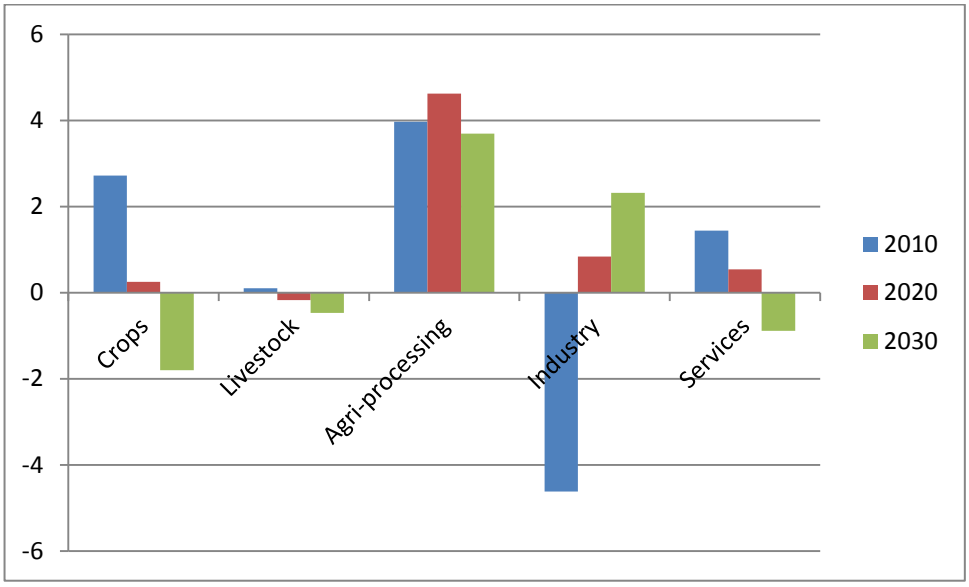


Figure 2-14 Indian net exports as percentage of production value

For agri-processing the patterns observed are slightly different. The demand for processed food products (dairy products, sugar, vegetable oils and fats, meats, food products nec, beverages and tobacco products, oilcake and molasses) increases because of the growth in incomes and dietary changes over time, while also efficiency of food processing increases, compensating for the low productivity and production growth in primary agriculture. During the first 10 years, the efficiency increase in processing is sufficient to compensate for the low efficiency increase in primary agriculture and so net exports of agri-processing as a share of production rise slightly. However, in the second period, from 2020 to 2030, this is not enough and the limited supply of primary agricultural commodities, constrains net exports of processed agricultural commodities which fall slightly over this period.

Industry shows a change from net imports towards net exports. Figures 2.12 and 2.13 show that the increase in exports is the main driving force behind this development; imports of

industrial commodities as fraction of production decrease only a little bit in the period 2010-2020, and not at all in the period 2020-2030.

For services, the exports and net exports as fraction of production are reduced. This is the consequence of two tendencies. First, the demand for services in India increases as a consequence of the growth in incomes and the use of more advanced technologies. Second, the demand for services in the rest of the world and therefore potential exports, grows much less than for industry. The Indian services sector thus seems to become less export-oriented.

2.4.5 Trade by destination

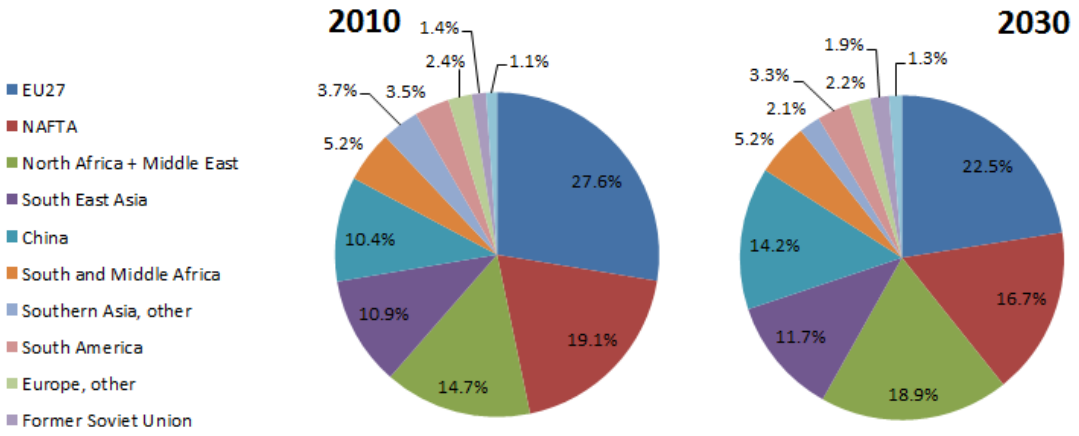


Figure 2-15 Destination of Indian exports (%)

In 2010 most Indian exports go to the EU27 and NAFTA regions. In 2030 the share of these regions is reduced to the benefit of North Africa and Middle East, and China (figure 2.15). This tendency is explained by differences in income growth, and changes in the specialisation pattern of India towards industrial commodities.

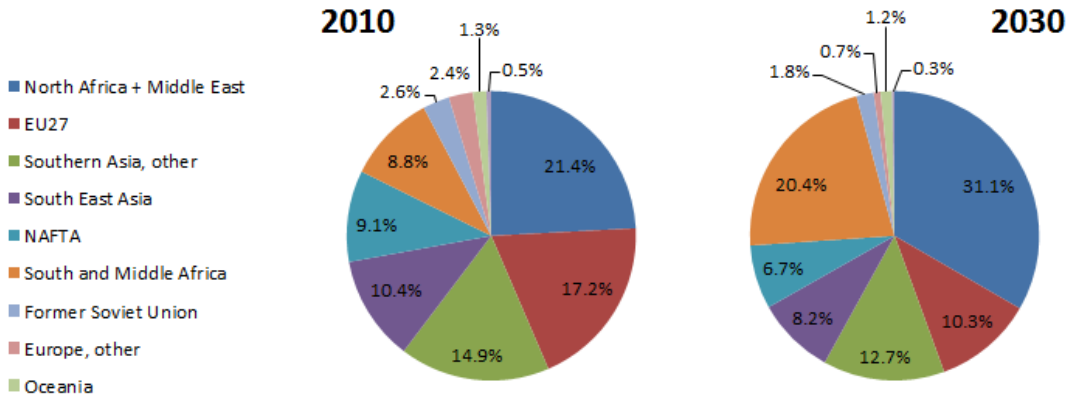


Figure 2-16 Agricultural exports of India by destination

Considering agricultural exports (figure 2.16), in 2010 the region North Africa and Middle East is the most important destination, followed by the EU and Southern Asia. In 2030, the share of Africa (North and South) and the Middle East has increased from 30% to 52%, while the share of the richer regions like the EU, China, South and South East Asia and NAFTA has fallen. This is a logical development: in regions where population and income growth is fast and starts at a low level, demand for agricultural products rises fast, while in the richer

regions and regions with less population growth, like the EU, demand for agricultural products rises only a little bit.

With respect to the source regions of imports (figure 2.17), the region North Africa and Middle East is with 27% of total imports the most important source in 2010, followed by the EU, South East Asia. In 2030 all three have a smaller share in Indian imports, while China, South and Middle Africa and South America become more important as source regions for Indian imports.

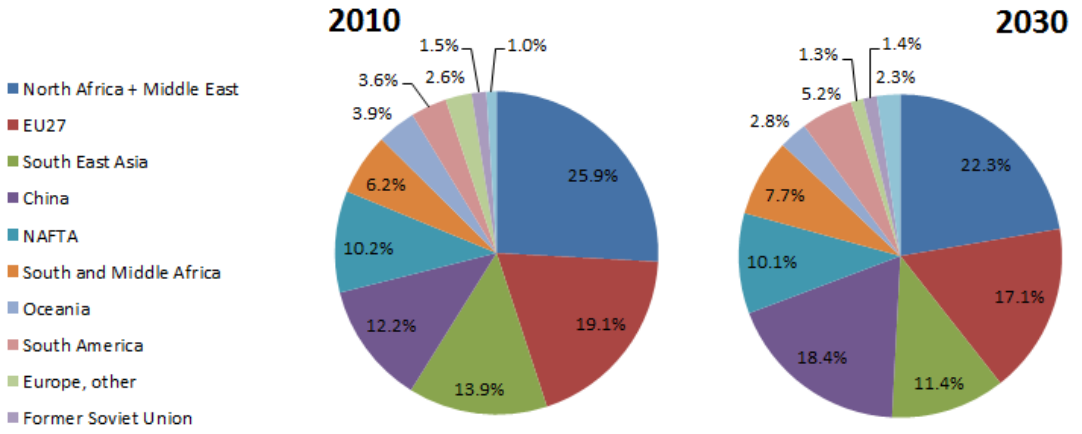


Figure 2-17 Imports of India by source (%)

If we look at agricultural imports of India (figure 2.18), the bulk is coming from NAFTA, South and Middle Africa and South East Asia. In 2030 the share of South and Middle Africa has increased a lot at the cost of NAFTA and South East Asia. This increase in market share of Africa is based on the assumption that expansion of land use in this region is possible and that through improvements in irrigation and other technologies a lot of increases in land productivity can be realized. Primary agricultural imports from the EU are only a little more than 3% of total Indian primary agricultural imports, but they are increasing slightly in importance.

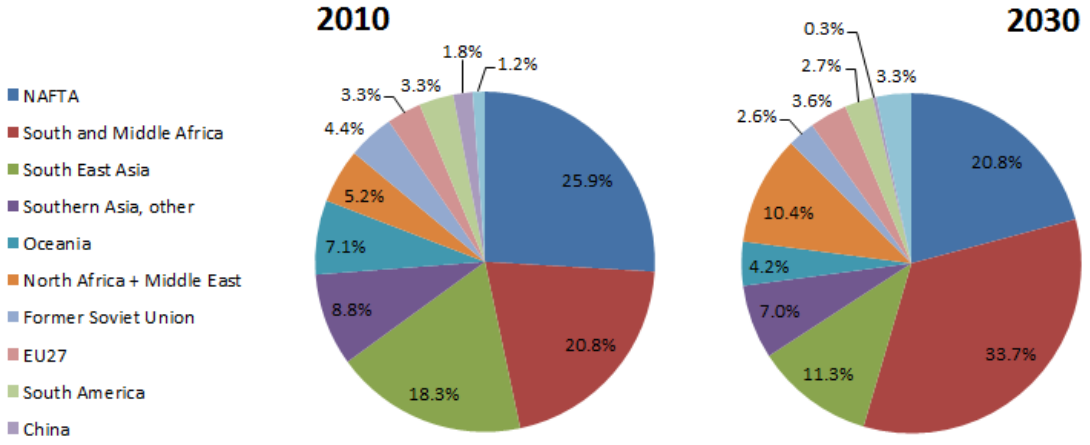


Figure 2-18 Agricultural imports of India by source

2.4.6 Trade between India and the EU

The focus of TAPSIM is on the relationship between India and the EU. If we analyse the importance of the EU for export of Indian sectors, we see a small and decreasing importance of crop exports, an increasing importance of the export of agri-processing industry, and a significant importance of industrial exports, rising to a share in production value of about 4%. The share of export to the EU in total Indian production value of services decreases from about 2.5% in 2010 to 1.5% in 2030.

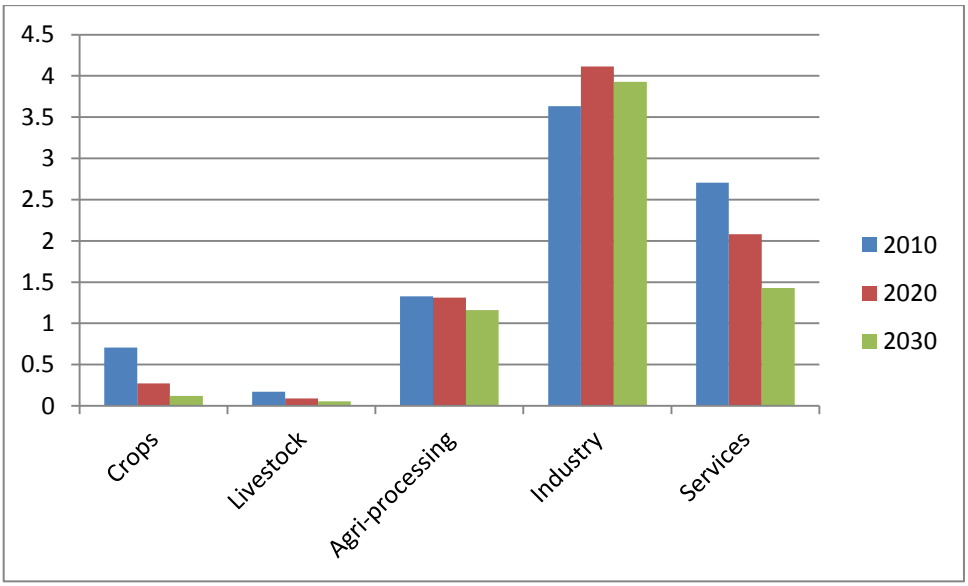


Figure 2-19 Exports by India to the EU as percentage of Indian production value

If we observe the importance of imports by India from the EU for the most important sectors, we see that trade in agricultural products is of minor importance, whereas that in manufacturing (3% of production value) and services (2% of production value) is of higher importance, although the importance is decreasing over time consistent with the general tendencies in Indian imports. The importance of imports of primary agricultural commodities as fraction of Indian production is rising very slightly.

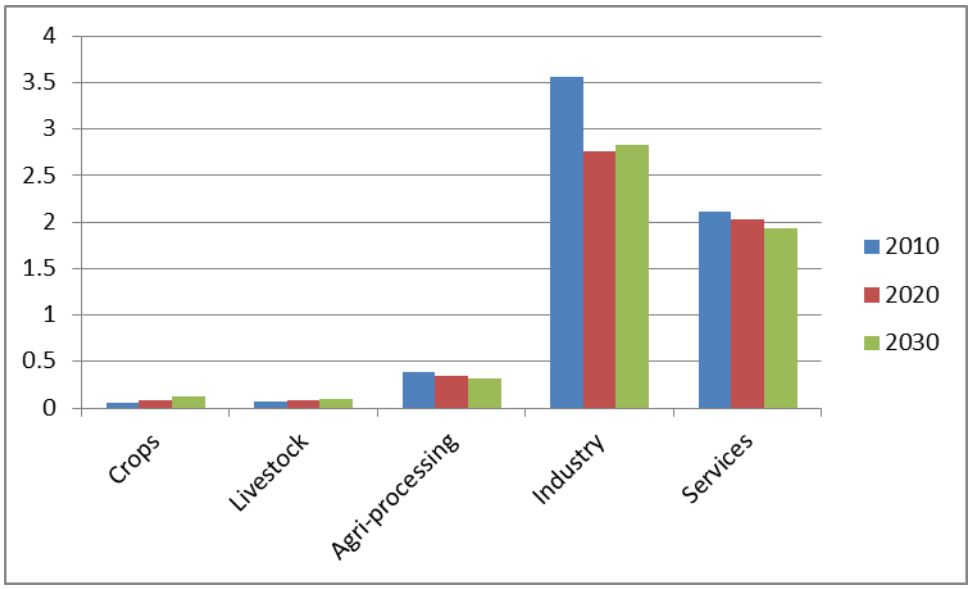


Figure 2-20 Imports by India from the EU as percentage of Indian production value

If we consider the importance of sectors at a more detailed scale the picture doesn't change much. It seems that especially for vegetables, fruits, plant-based fibres, other crops and animal products there is a potential for growth in exports from India to the EU.

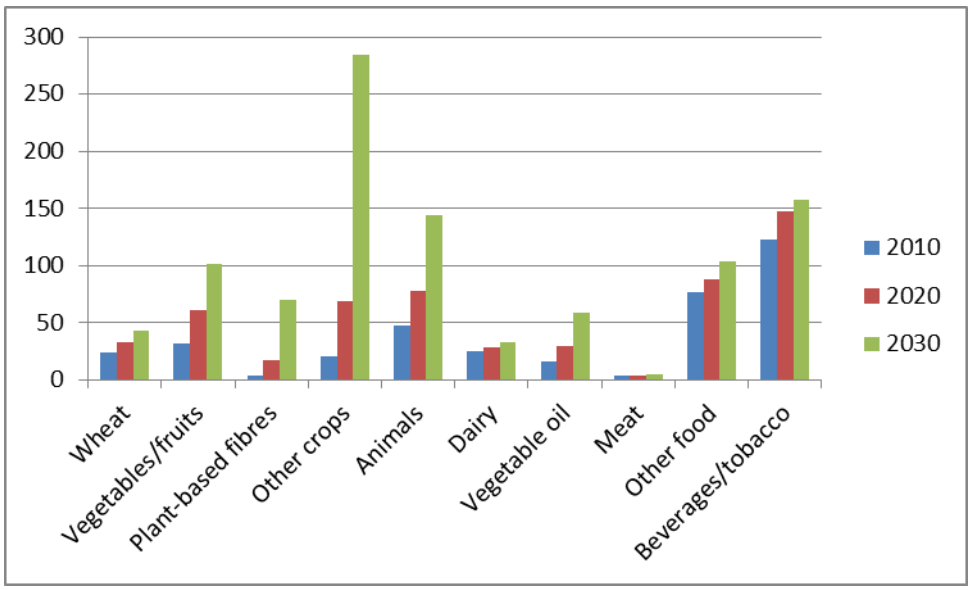


Figure 2-21 Volume of exports by India to the EU in constant 2007 dollar prices

2.4.7 Land use and intensification

With the growth in population and rising incomes in India, the tension on the land market from rising demands for agri-food commodities increases. This was already obvious in the relative price development of primary agricultural commodities in India, and is also visible in the development of the land price in both crops and livestock sectors (figure 2.22).

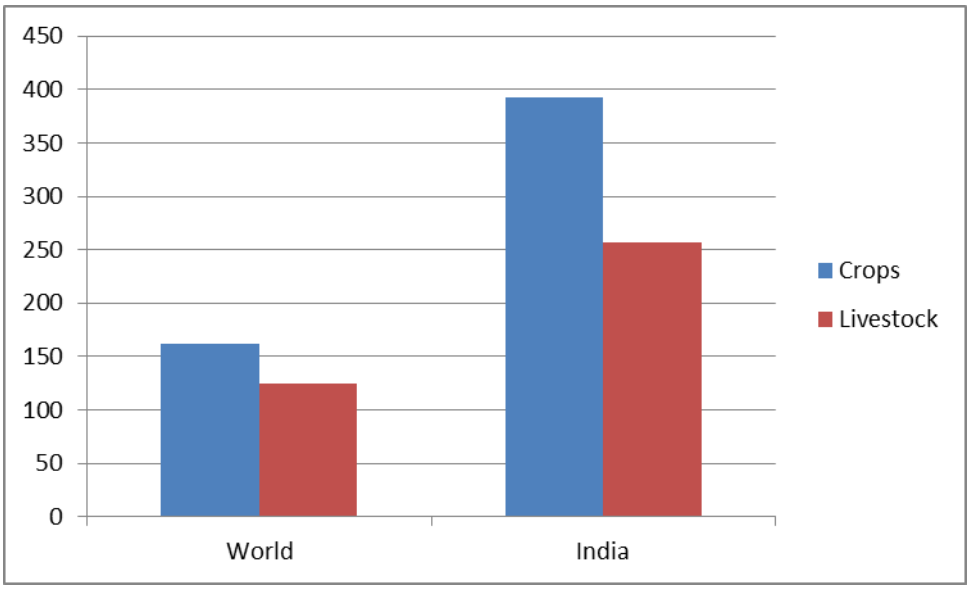


Figure 2-22 Percentage change in land price 2010-2030

As a consequence of the fast increase in land prices, Indian agriculture is intensifying more than in the rest of the world. This intensification implies that more capital per ha is used, for example for irrigation purposes, but especially that more fertilizer is used per hectare, partly because better irrigation creates the possibility of multi-cropping (figure 2.23). The assumed elasticity of substitution between land and fertilizer of 0.8 is a crucial factor in this intensification effect (where fertilizer may also stand for other inputs that help to increase land productivity).

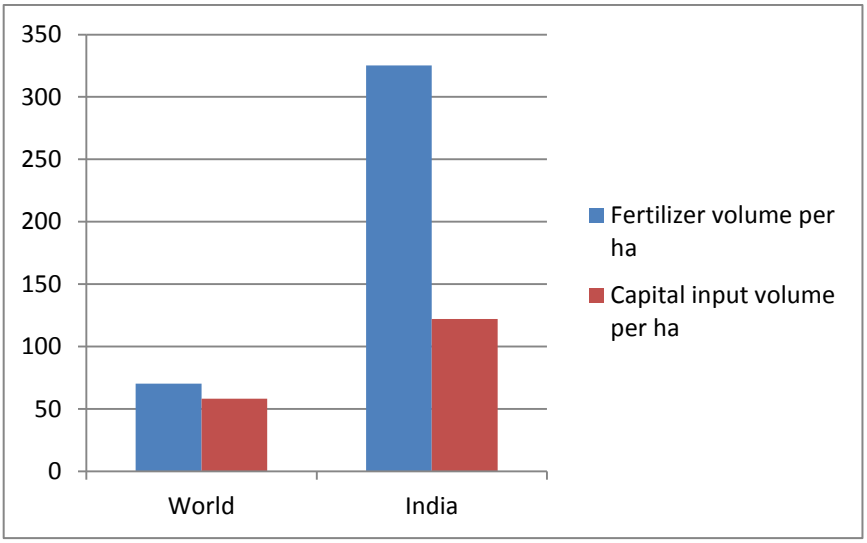


Figure 2-23 Percentage change in input per ha (2010-2030)

The consequence of the intensification process in India is shown in figure 2-24, showing how the production per hectare of different crops in India is rising much faster than in the rest of the world and, notably, in the EU. This intensification and general productivity improvement is an important explanation of why India is able to grow so fast without becoming too dependent on the rest of the world for food (figure 2.12-2.14). One should be aware that if India is not able to realize this productivity increase, a problem may arise in that its reliance on the world market for food in terms of food imports and so vulnerability to changes in world food prices increases. This is in line with Binswanger-Mkhize (2012) which asserts

that an acceleration in terms of more rapid productivity and irrigation growth is needed to satisfy the increasing growth in food demand that follows rapid economic growth and rising standards of living.

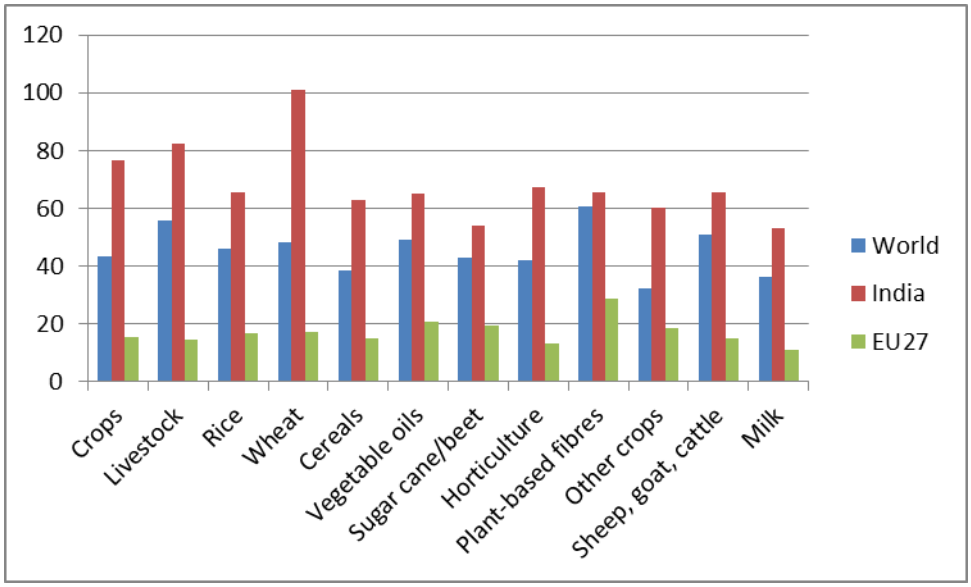


Figure 2-24 Percentage change in production per ha 2010-2030

2.4.8 Employment and income

The structural changes that are occurring over time in India have consequences for employment (figure 2.25). Since we don't have absolute employment levels in the model, we use the development of the wage bill in constant 2007 dollar prices as an indicator. According to this indicator, employment in agriculture is reduced by about 25%, and employment in industry respectively services is growing with 14% and 41%. In line with structural changes over time (figure 2.9), the fast growing industry and services sectors withdraw labour from agriculture (including processing sectors). Note that in all sectors productivity growth has two opposing effects on labour demand: 1) given output, less labour is needed in the production but 2) output is also boosted by productivity growth, counteracting the first effect. It is clear from figure 2.25 that the second effect outweighs the first effect in both industry and services. This labour comes from agriculture (including processing).

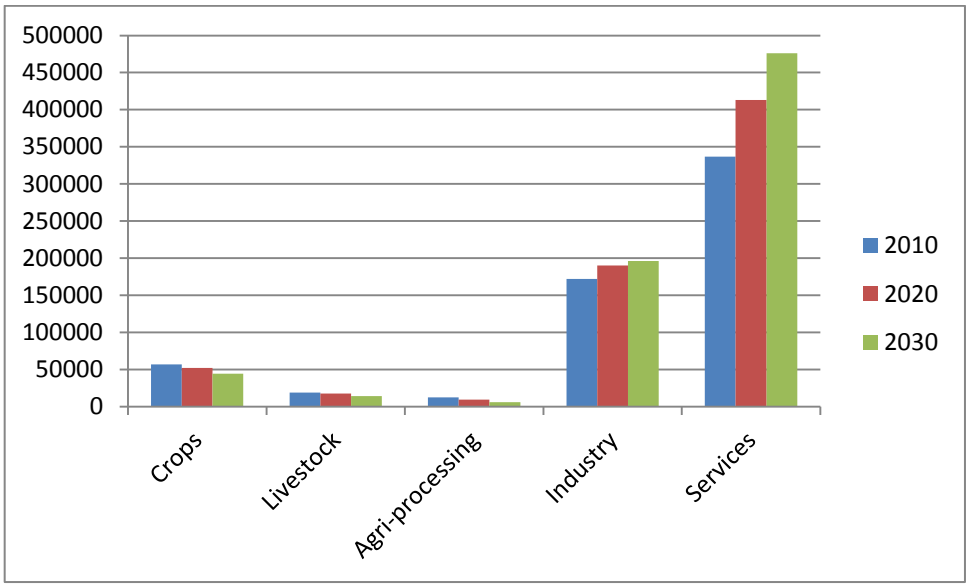


Figure 2-25 Employment indicator (in mln dollars of 2007), volume

The movement of employment from agriculture to industry and services implies migration towards other regions and changes in required skills. Also asserted by Binswanger-Mkhize (2012), this process is not smooth; there is a tendency for labour to stay longer within the agricultural sector even if wages in other sectors are higher. According to Binswanger-Mkhize, rural-urban migration remains slow, primarily because the urban sector is not generating large number of jobs in labour-intensive manufacturing. As a result, the development of wages in agriculture is lagging behind the development of wages in the whole economy. While the wages in industry and services increase between 200% and 250%, the wage rate in primary agriculture rises by only 150% (figure 2.26). This is in line with the development in agricultural output per worker as reported by Binswanger-Mkhize (2012), which from 1990 to around 2010 increased by roughly 130%.

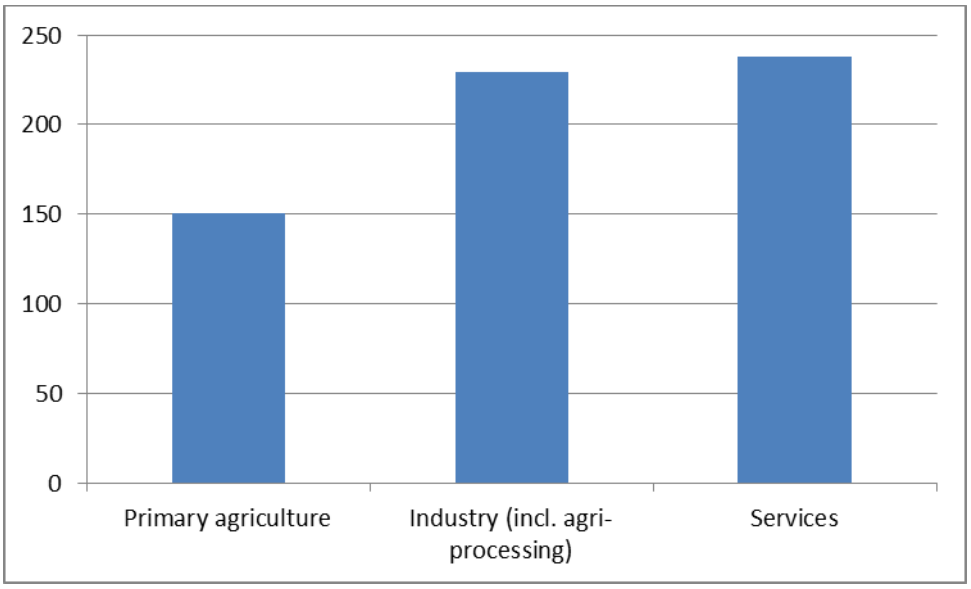


Figure 2-26 Real wage development in India 2010-2030 (% change)

As a consequence of changes in wages, capital rewards, land rent changes combined with changes in the employment of these factors, the share of GDP generated in the different

sectors changes. Figure 2.27 shows that the share of primary agricultural income decreases from about 14% in 2010 to 10% in 2030, while the share of service income increases from 56% to 64% over the same period. Also the share of industrial income falls from 29% to 26%; this is not the consequence of a bad development of wages nor of a bad development in production volume, but mainly the consequence of the increases in productivity. These patterns are in line with those reported by Binswanger-Mkhize (2012) for the Indian economy. This study finds that the share of agriculture in GDP declined to about 15% in 2010. Similarly, the share of services increased to around 55% in 2010, leading to a share for industry of 30% in 2010.

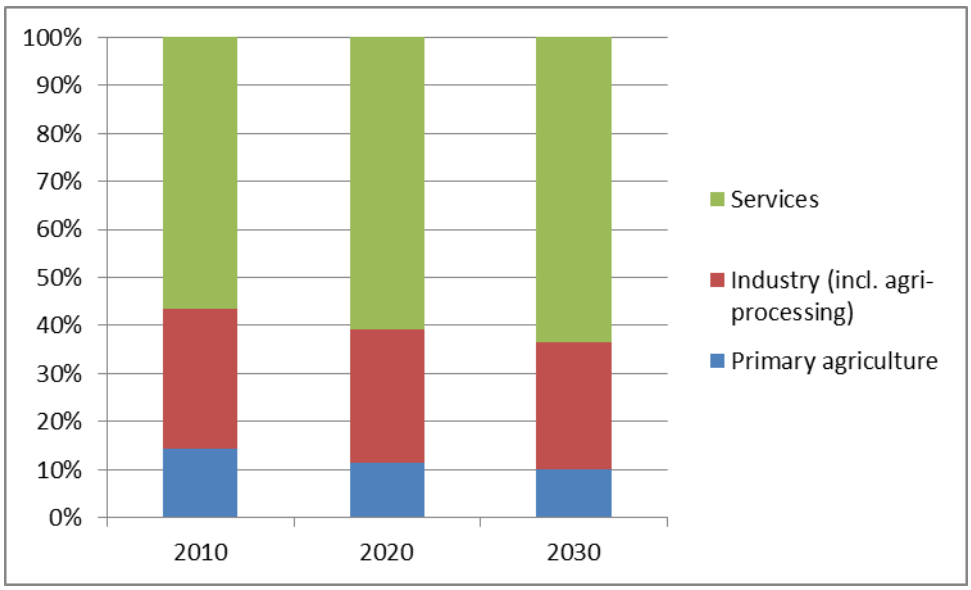


Figure 2-27 GDP shares of sectors in India

2.4.9 Conclusion

The baseline shows an increasing importance of industry in Indian production and exports, and a reduction in the importance of primary agricultural commodities. Not only is the latter constrained by land and water availability, industry benefits from relatively high rates of technological progress. Another part of the explanation lies in changing Indian demand patterns, shifting away from food towards expenditures on manufactured goods and services. The agricultural sectors however still grow, but given preference shifts and developments in comparative advantages especially the sheep, goats and chicken, wheat and milk sectors benefit. With respect to trade relations, in terms agricultural and overall trade, the EU's importance for India falls, with the exception of agricultural imports, where the EU's importance as a source region rises slightly. Increased demand for land leads to intensification in land use, which ensures that India is able to grow fast without becoming too dependent on the world market for food. The consequences of the development of India for incomes depends to a large extent on the possibility to increase mobility of labour from rural to urban areas and from agriculture to industry and services.

2.5 Some methodological issues

Originally CGE models were used to analyse the impacts of specific policies. The methodology of the development of baselines is quite recent, and is still under development. For example, it is exceptional that a CGE model is validated based on past performance, and

a lot of parameters in the model have a very weak empirical foundation. It is also exceptional that it is usually assumed that factor productivity grows with the same rate for all sectors and production factors. Our methodology, to vary the distribution of technological change over sectors in line with structural economic changes observed over time, is therefore much more advanced than a lot of other studies. Whilst the empirical foundation of the choices and assumptions made may at times be weak, our analysis does draw from and is comparable with empirical analyses available for the Indian economy, with focus on agriculture.

A particular issue of concern is trade. Armington elasticities, i.e. the elasticities that determine the choice between use of imported and domestic commodities or the region from which commodities are imported, in general have a weak empirical foundation. Estimated elasticities are too low for plausible outcomes, but also the elasticities normally used seem at the low side. For this reason, we have first experimented with Armington elasticities that are higher with small market shares, but when we do this in a general way the cure may be worse than the disease. For this reason we kept the standard Armington elasticities.

A CGE model assumes equilibrium, while we know that the world economy is never in equilibrium. The large changes in real exchange rates cannot be explained in current CGE models, while they obviously influence competitive positions a lot. In calibrating technology in the model, it is assumed that production factors are fully used, something that does not do justice to the recent years of crisis. This implies that the fluctuations in GDP growth have less to do with technology change and more with endowment availability, something that is not included in the model. Nevertheless, we hope that the long-term tendencies are roughly correct.

With respect to land productivity development, a combination of exogenous FAO projections and GDP dependent projections is used. Next to this, possibilities for intensification using more fertilizer and more capital are in the model, but calibration of the elasticities remains a difficult task. Complex institutions, like the fertilizer and irrigation policies in India, may influence the outcomes for land productivity a lot, while social processes restrict the effectiveness of introducing new technologies. In the end, the results of the simulations should be interpreted as potential outcomes given the assumptions made, not predictions.

As is obvious from the discussion above, a lot of uncertainty is involved in the development of the baseline, and a lot of opportunities exist to develop CGE models further in calibrating the parameters based on developments in the past. Nevertheless, we have to use the results as a starting point, and the results are helpful in thinking over the crucial factors that determine the development of the Indian and world economy in the future, and the complex interrelationships between those developments. Furthermore, since we are interested in the impacts of alternative Indian growth paths and trade policies in difference from the baseline, the specific developments in the baseline may not influence the results of the impacts of policies in a very fundamental way (they are taken out). In other words, it is more important to have a point of reference as a starting point for scenarios, rather than that this point of reference is exactly right.

2.6 Conclusion

Experience with the model shows the crucial importance of assumptions about relative productivity developments in different sectors in different countries. Relatively small adjustments may have large effects. This shows that it is of crucial importance to focus investigations on the plausibility of productivity assumptions. Another issue is the importance of demand elasticities and the reaction of imports to relative price developments. Finally, some substitution parameters, like the substitution between fertilizer and land, are crucial in

creating forces towards equilibrium in the agricultural markets, especially in the case when imports are assumed to be restricted in some formal or informal way.

The baseline that has been created is a point of reference for further thinking on the future of the Indian economy within the global economy. It should not be seen as the final truth, but is useful as a point of reference for different scenarios. In chapter 3 we will focus on a very specific question, i.e. what is the effect of Indian growth on India and the rest of the world? In deliverable 7.2 we look at the impact of trade policies.

3 The impacts of Indian growth

3.1 Introduction

One of the issues in TAPSIM is how the growth of the Indian economy influences the rest of the world. In order to investigate this issue, variations of the baseline are created with higher and lower economic growth in India while the growth of the rest of the world remains the same. This is an artificial experiment, because growth between regions in the world is normally related. It is also a difficult experiment in the sense that you have to define what the causes are of the differences in growth performance. It could be a difference in openness of the Indian economy, but this would influence the rest of the world. In this chapter it is assumed that the fundamental cause of the difference in Indian GDP growth is faster technological change. It is assumed that the distribution of this technological change over sectors and inputs is the same as in the baseline.

In total three scenarios are calibrated that only differ in the assumed rate of Indian GDP growth: 6%, 8% (as assumed in the baseline) and 10% yearly Indian GDP growth between 2010 and 2030. This implies that for the 6% growth rate, GDP is 17% lower in 2020 and 31% lower in 2030 compared to the baseline. For the 10% growth rate scenario, GDP is respectively 20% and 44% higher than in the baseline. This experiment is used to say something about the effects of higher growth on the Indian economy and the rest of the world.

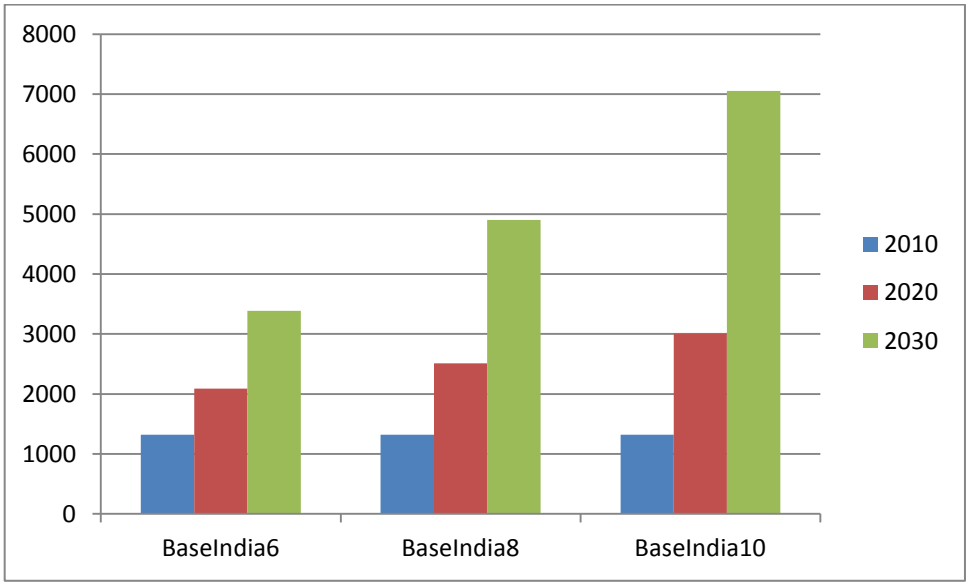


Figure 3-1 GDP per capita in the three growth scenarios (million 2007 dollars)

The change in growth rate not only has consequences for GDP per capita at the end of the period, but also for the relative positions of technological change. Figure 3.2 shows that technological change differences (measured for the factor labour only, i.e. showing the change in the output per unit of input of labour) between sectors are more pronounced in the BaseIndia10 scenario than in the BaseIndia6 scenario. This is the consequence of the cumulative character of technological change, and has important consequences for the competitive position of the different sectors.

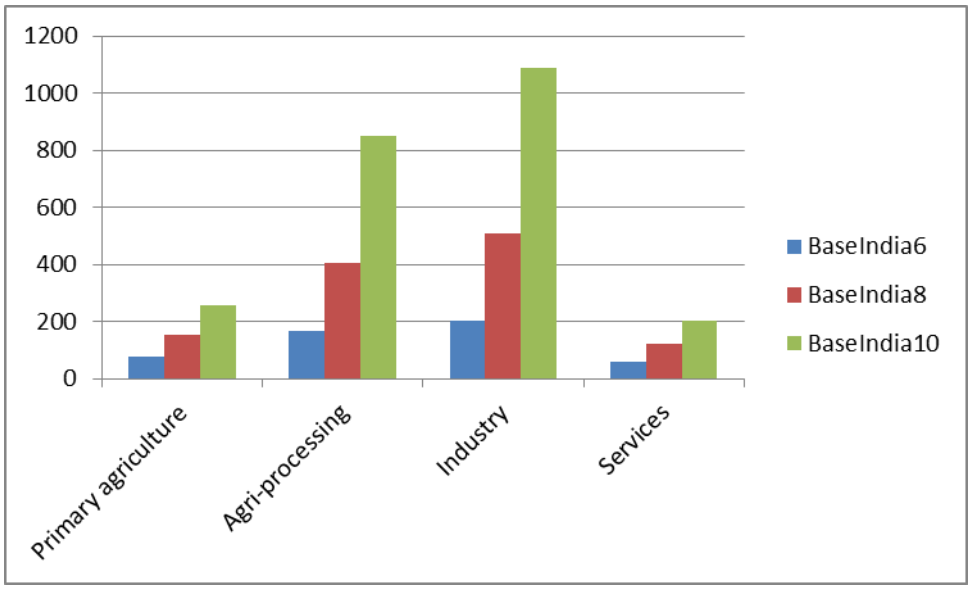


Figure 3-2 Labour saving technological change 2010-2030 (%)

3.2 Consumption

Additional growth implies a change in consumption patterns because demand for agricultural products responds much less to income changes than demand for industrial products and services. Figure 3.3 reports the change in per capita volumes consumed by households in 2030 (measured in constant 2007 dollars). It shows that both consumption demand for industry and services doubles between the 6% and 10% growth scenario, while primary agriculture grows with only 1% and demand for processed food increases by about 6%. In general, demand for high-valued food increases more than for low-valued food.

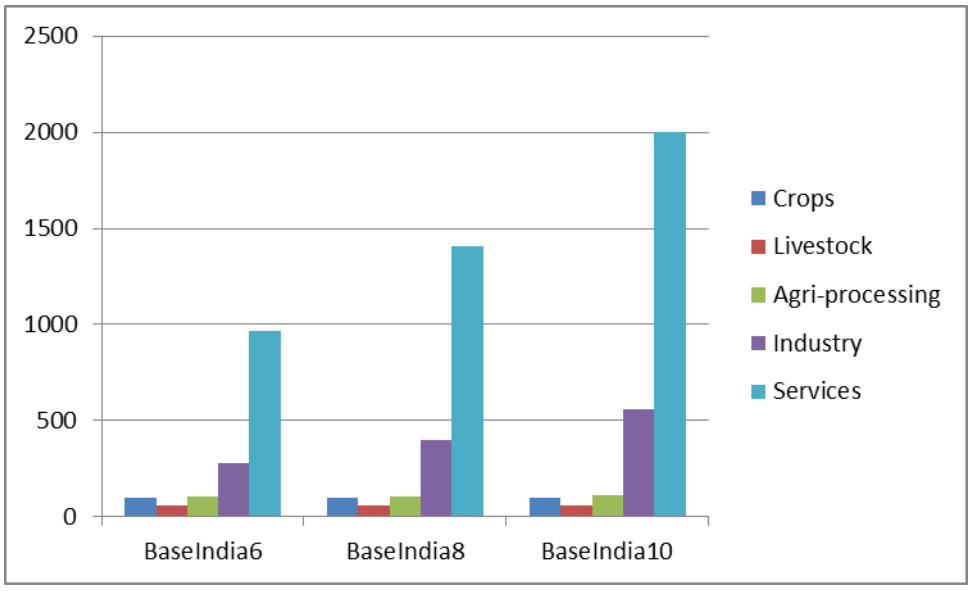


Figure 3-3 Private consumption volume per capita in 2030 (million dollars of 2007)

3.3 Production and trade

Production follows more or less the same pattern as demand (figure 3.4).

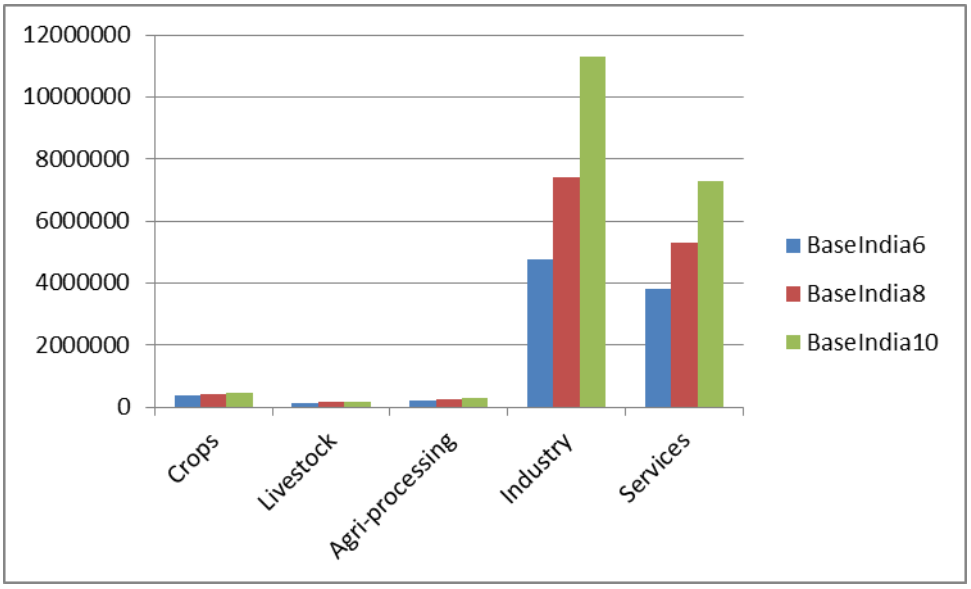


Figure 3-4 Production volume in 2030 (million dollars of 2007)

The difference in demand and production equals net exports. It is quite clear that the increase in demand generates a shortage of crops that is not compensated sufficiently for by increased productivity; if the effect of GDP growth on land productivity would be higher the net imports of crops would probably be smaller. For industry and services the effect of faster growth is very pronounced: for industry small net imports in the 6% growth scenario change into 4% net exports in the 10% growth scenario, while for services almost 2% net exports in the 6% growth scenario change into more than 2% net imports in the 10% growth scenario (figure 3.5). In summary, the growth of the Indian economy has a large influence on its net export position.

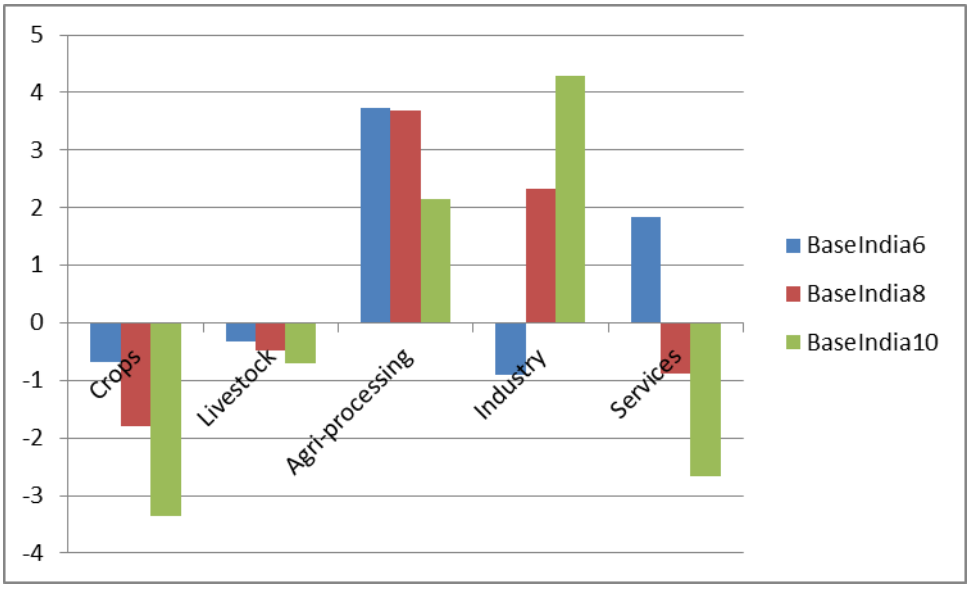


Figure 3-5 Net exports of India in 2030 as percentage of production

Looking at agricultural sectors only (figure 3.6), we see that the differences in net exports are not revolutionary. Only for cotton and other non-food crops a large surplus in 2010 transforms into a large deficit in 2030, and for (luxury) horticulture commodities net imports increase. With respect to cotton, the explanation is that production grows much less than the demand by the textile industry, as Indian demand for textile has an income elasticity of consumption that is higher than 1. As a consequence, also the exports of textile as a share of production fall, although textile exports still grow by 180% between 2010 and 2030 in the 10% growth scenario.

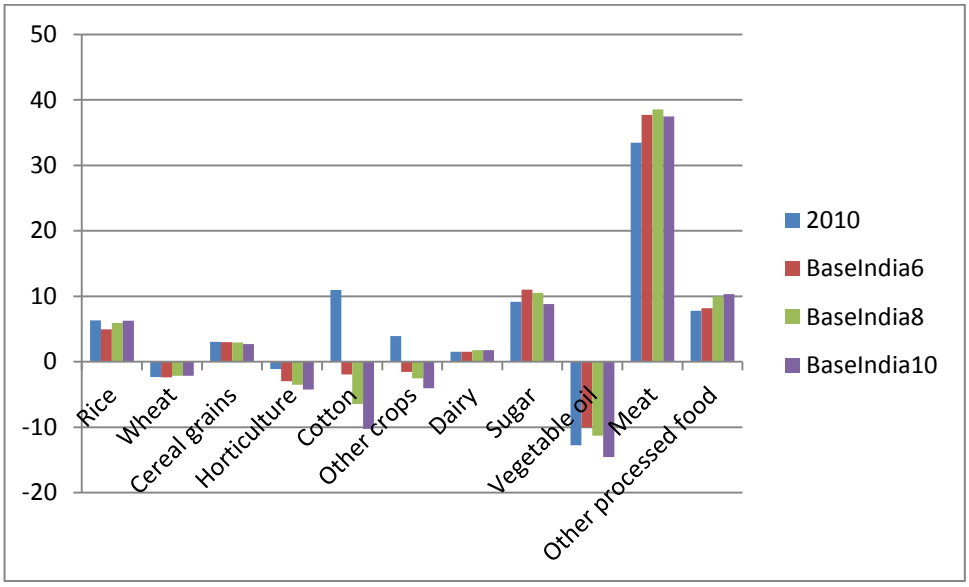


Figure 3-6 Net exports as percentage of production, 2010 and 2030

If we look at the final impact of Indian growth on production in the rest of the world, the impacts seem to be small. Table 3.1 shows that although production volume in India changes a lot with different growth rates, the effect on the EU and the rest of the world seems to be small. The largest effect is on industry, that produces 2% less if India grows with 10% instead of 6% per year. This is not surprising since India is relatively more competitive in industry in the high growth scenario.

Table 3-1 Percentage difference in production in 2030 when India grows with 10% instead of 6% per year

	India	EU27	Non_EUIndia	Non_India
Primary agriculture	25.31	0.43	0.27	0.29
Agri-processing	24.31	0.16	0.1	0.11
Industry	137.97	-2.28	-1.74	-1.84
Services	90.73	0.67	0.39	0.46

3.4 Exports by destination

The shares of different destinations of exports follow more or less the pattern of the baseline (figure 3.7), where the change in growth of total exports is higher than the change in GDP growth. Africa and Middle East have a tendency to slightly increase their market share.

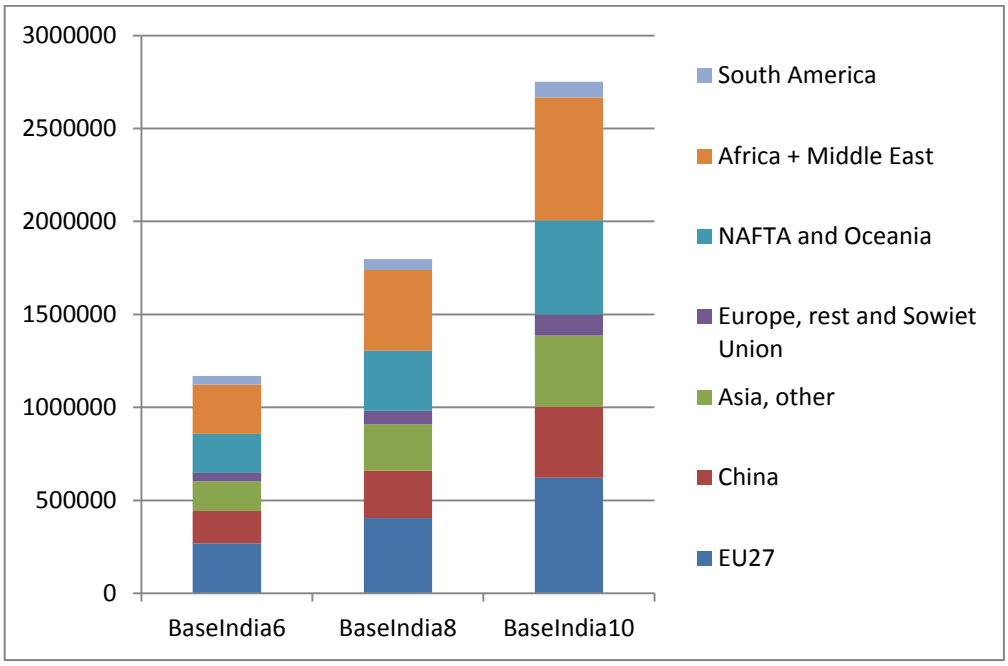


Figure 3-7 Total Indian exports by destination (million 2007 dollars in 2030)

For primary agricultural exports, the impact of Indian growth is completely different (figure 3.8). The general tendency is that in the high growth scenario agricultural exports decrease, especially towards Asia. However, exports to Africa show a large increase if India grows faster. Nothing much happens with agricultural exports from India to the EU27.

For processed agricultural commodities (figure 3.9), the picture is again different than for primary agricultural commodities. Specifically, exports increase by about 25%, where the increase is almost 50% for exports to Europe, Oceania and NAFTA. Technological progress in India makes it more beneficial to export processed food commodities instead of primary agricultural commodities, and the best markets for these processed food commodities are the richer regions.

The main impacts on exports of Indian growth are, however, felt in industrial commodities (figure 3.10). The increase in exports is 180%, and it seems that all regions benefit to the same extent, although growth towards China (that is industrializing itself) is somewhat less than towards other rich regions of the world.

With respect to services, faster growth of the Indian economy implies less service exports, about 25% reduction with 10% growth compared with 6% growth, and the change is distributed more or less equally over the different regions (figure 3.11). This pattern is the same as was observed in the baseline.

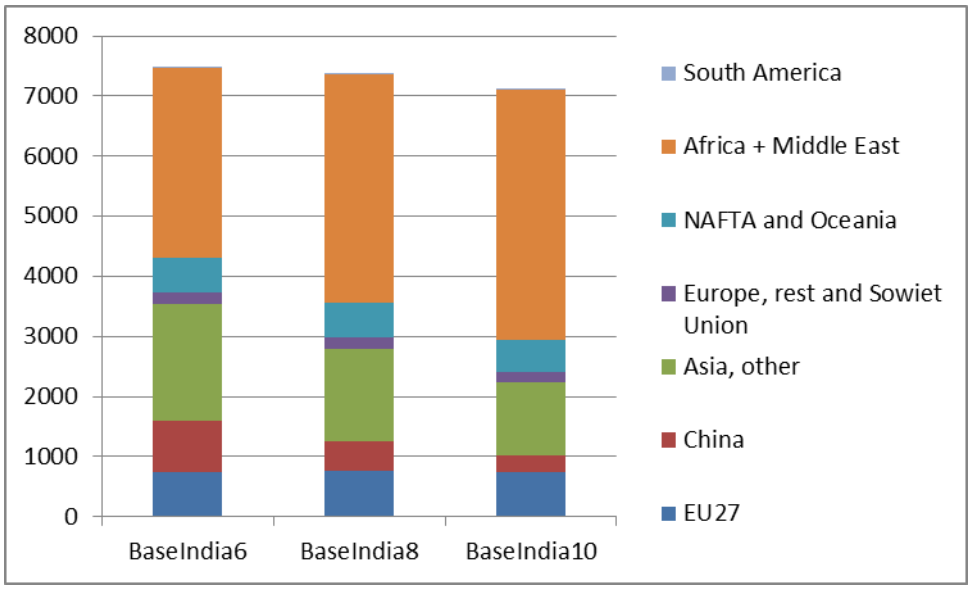


Figure 3-8 Indian exports of primary agricultural commodities (million 2007 dollars in 2030)

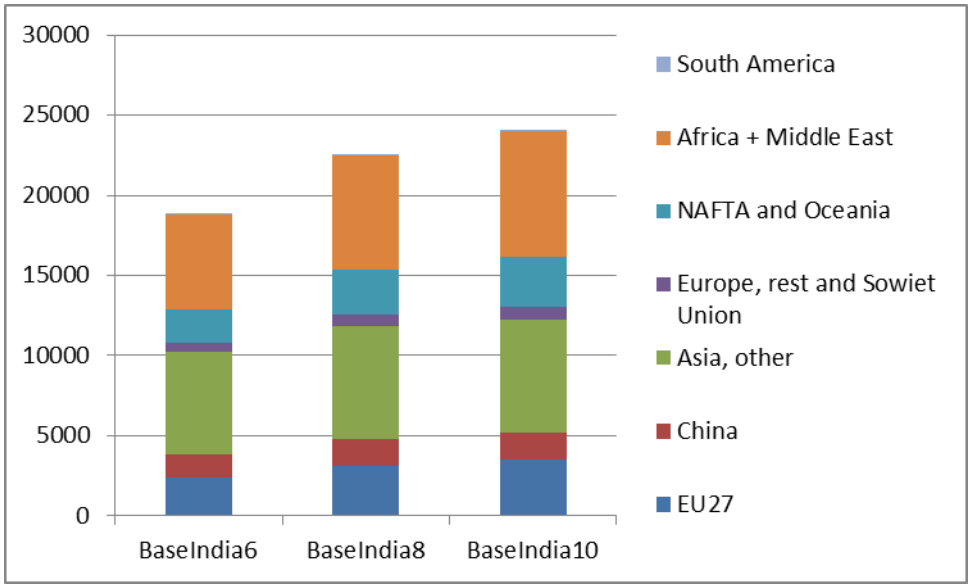


Figure 3-9 Indian export of processed agricultural commodities (million 2007 dollars in 2030)

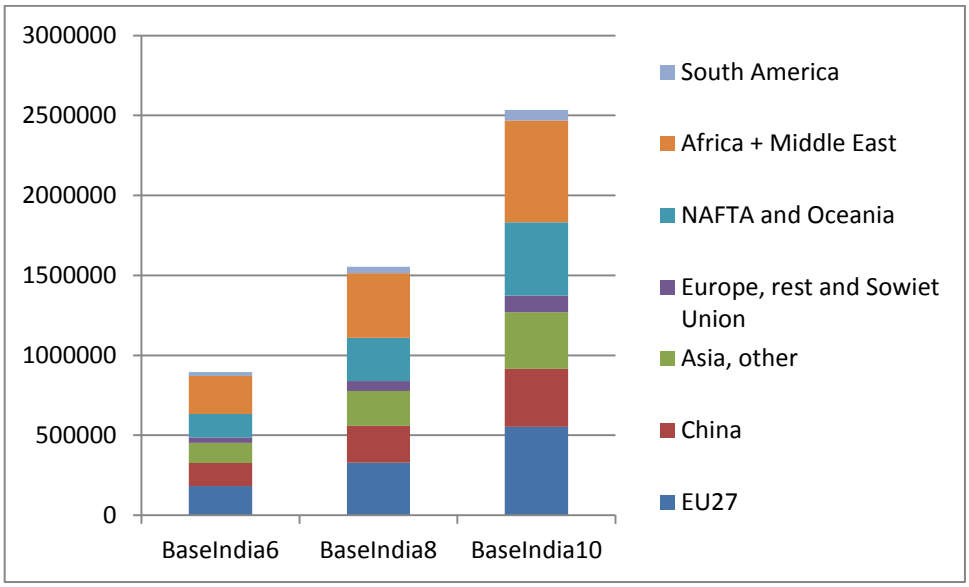


Figure 3-10 Indian export of industrial commodities (million 2007 dollars in 2030)

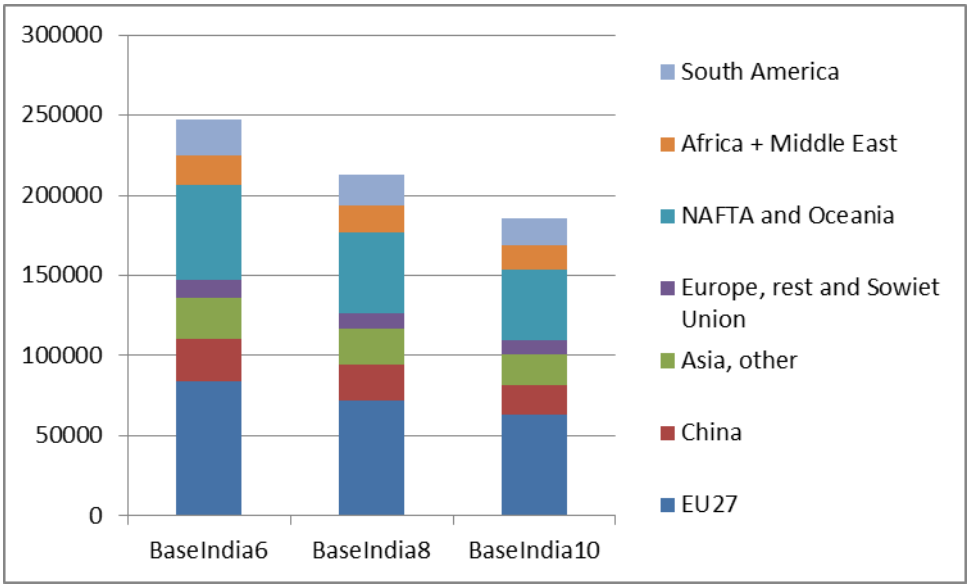


Figure 3-11 Indian export of services (million 2007 dollars in 2030)

3.5 Imports by source

With respect to imports: they are about 70% higher in the 10% growth scenario than in the 6% growth scenario, while GDP is more than 100% higher. The import growth is more or less the same for all regions of the world, although slightly more is coming from South America and slightly less from China.

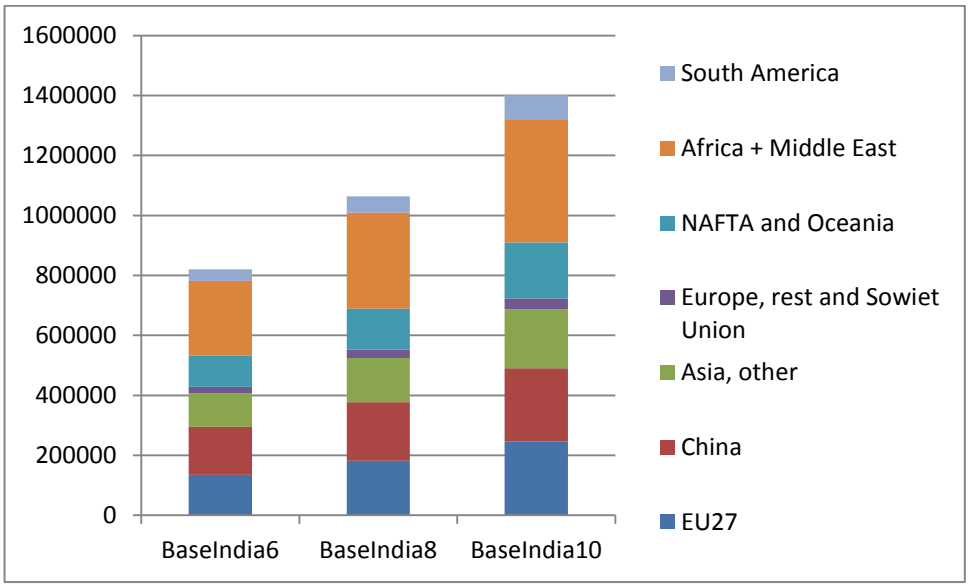


Figure 3-12 Indian total imports (million 2007 dollars in 2030)

For primary agriculture, the import growth of 160% is faster than GDP growth, and it seems that this benefits the EU27 relatively more than other source regions. The same is true for Africa.

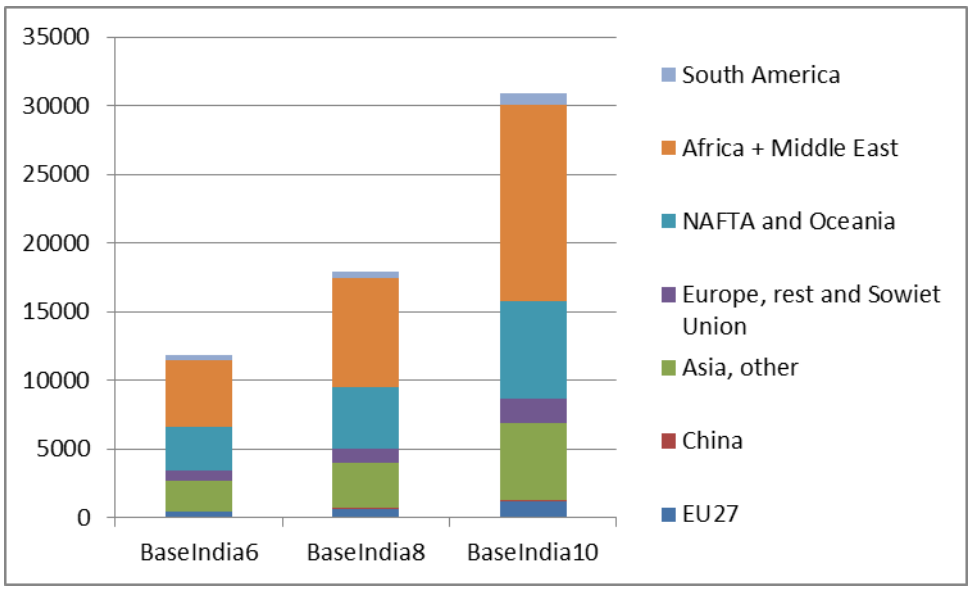


Figure 3-13 Indian primary agricultural imports (million 2007 dollars in 2030)

For processed agriculture imports (figure 3.14), the demand growth of 50% is much less than GDP. Source regions that benefit are Asia, Africa and South America, while the EU hardly seems to profit with a rise in demand from India of only 13%. Also the growth in imports from China, NAFTA and Oceania is relatively small. For industry, the rise in imports is also about 50%, but this is distributed more or less equally over all regions, including the EU, and therefore is not presented separately. Also for services there is not much of a shift in distribution between regions, where the general increase in service demand by 125% much higher than the growth in GDP.

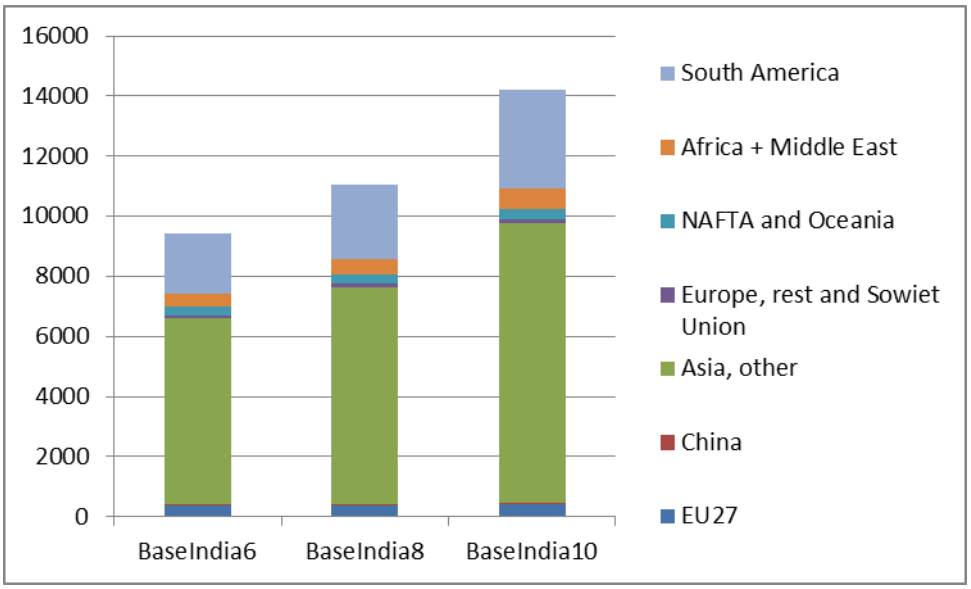


Figure 3-14 Indian processed agricultural imports (million 2007 dollars in 2030)

3.6 Land use and intensification

Faster growth of the Indian economy increases the pressure on land as can be seen in figure 3.15. This is caused by the assumption that land productivity increases only a little bit with GDP growth, and by the relatively slow reactions of imports to changes in relative prices as implied by the Armington assumption (the Armington elasticities are still higher than used in the national CGE of India). As a consequence of this, the prices of agricultural commodities in India increase a lot compared to the rest of the world (figure 3.16). In the 10% growth scenario, crop prices tend to increase by 50% more than in the rest of the world. This may generate a tendency to loosen import restrictions, and perhaps also a stronger reaction of imports on relative domestic price changes in future.

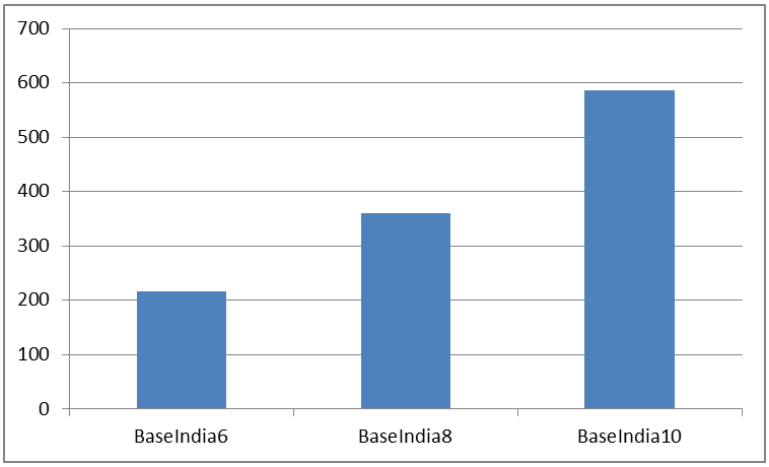


Figure 3-15 Percentage real land price increase in India 2010-2030

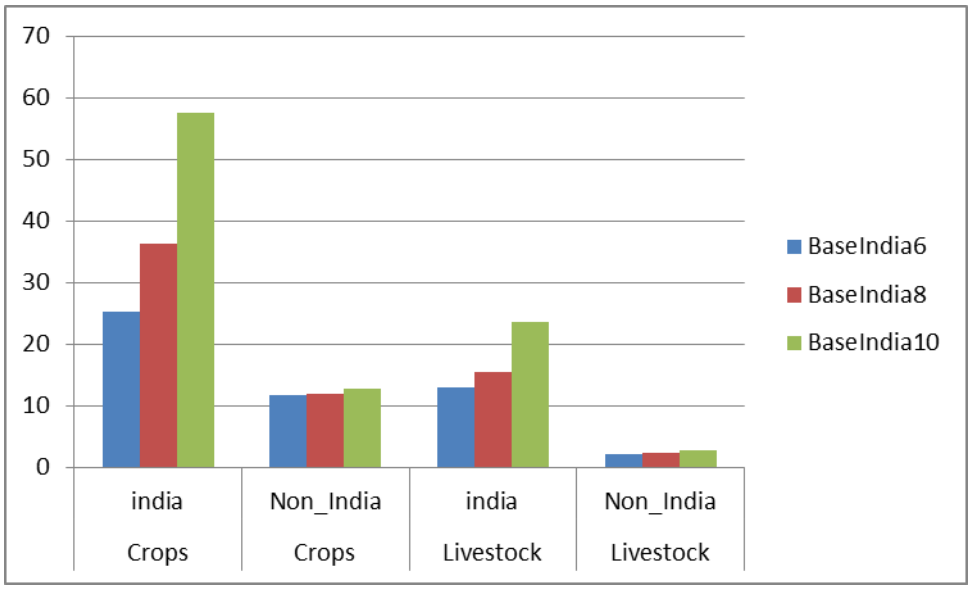


Figure 3-16 Percentage change in crop and livestock prices 2010-2030

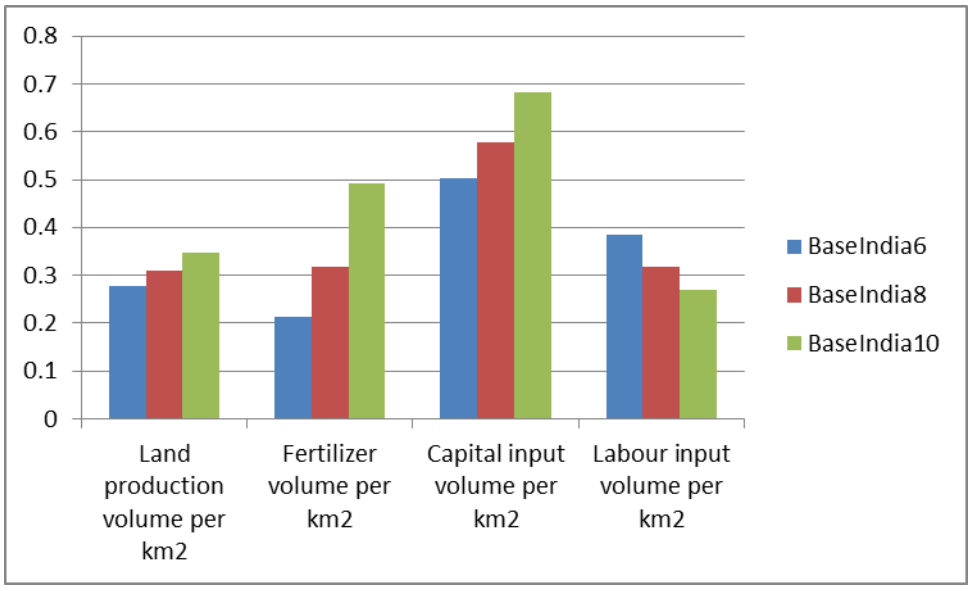


Figure 3-17 Indian growth, land productivity and intensification (input costs multiplied by 10).

The consequence of the increase in land prices is intensification. Figure 3.17 shows that land productivity increases by about 25%, whereby capital input per km^2 rises with 35%, and fertilizer input more than doubles. Labour input is reduced as a consequence of higher wages and general productivity increases. This intensification process is caused by the high domestic demand in India. As noted before, a more flexible import policy may reduce these effects, which at the same time will increase the impacts on agriculture in the rest of the world. Also, if exogenous factors influencing land productivity cause it to increase more with GDP growth, the impacts on land price, Indian agricultural prices and intensification will become smaller. More generally, as suggested by Binswanger-Mkhize et al. (2012), technical progress will be the ultimate source of agricultural growth necessary to lower pressures on the use of scarce resources. They find that if imports are constrained to levels only slightly higher than present now, an agricultural growth rate of 4% or more is needed to support GDP growth rates in excess of 8%. This can be attained by a slightly higher TFP growth in

agriculture of 2% combined with a higher irrigation potential. They also note that global warming will increase the need for TFP growth.

3.7 Employment and income

The growth of India changes the composition of employment significantly. The share of service employment increases, while the share of agriculture employment decreases at the cost of employment in primary agriculture and industry (figure 3.18). If we look at the shares of sector income in total income (figure 3.19), the pattern is roughly the same: more growth implies an increase in the share of services at the cost of industry and agriculture. The share of primary agricultural income is relatively higher than for employment, as land income forms a significant part of value added in agriculture in India and land prices tend to explode.

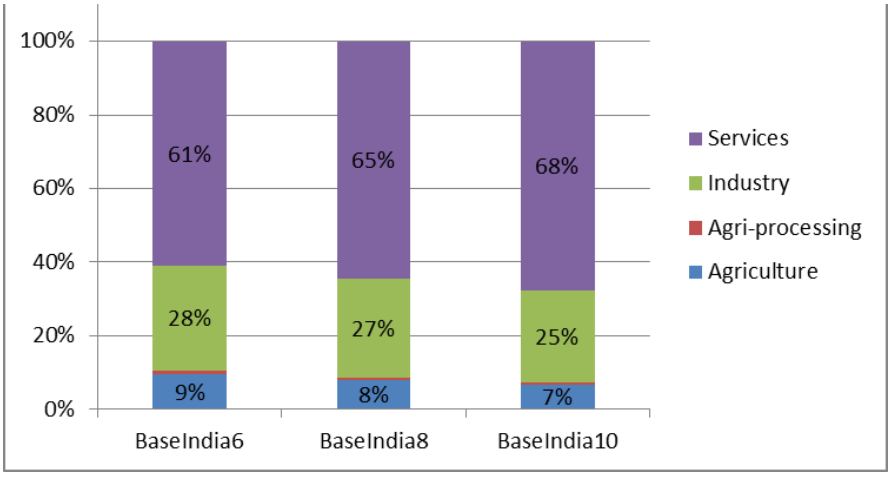


Figure 3-18 Change in sector employment structure in 2030

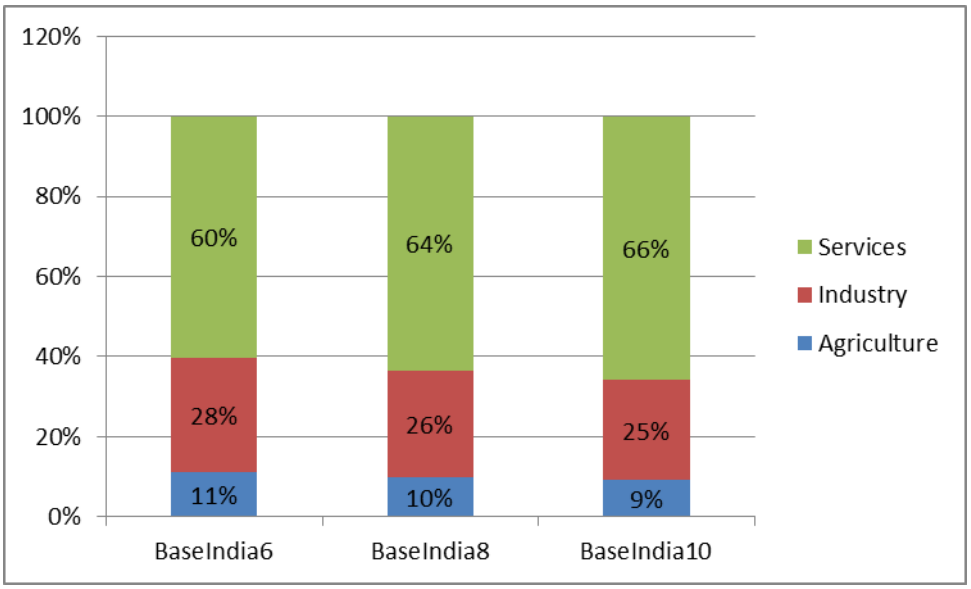


Figure 3-9 Change in sector income structure 2030

We also investigate poverty impacts, using an extremely rough indicator for poverty. If we are willing to assume that poverty in rural areas is determined by the development of unskilled wages in agriculture relative to the development of primary agricultural prices, in

the period 2010-2030 the agricultural unskilled wages rises by 50% more than agricultural prices, implying a welfare increase for the rural poor. With faster growth, this welfare indicator improves going from 6% to 8% yearly GDP growth, but it slightly deteriorates if growth rises from 8% to 10%.

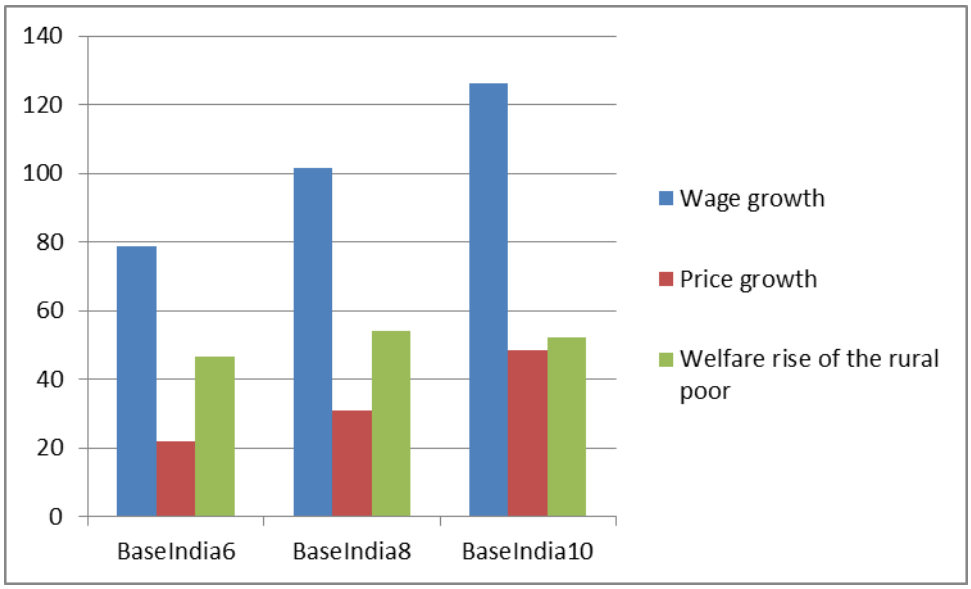


Figure 3-9 Wage and price growth in primary agriculture, and the rise in real income of the rural poor, 2010-2030

3.8 Conclusion

Faster growth of India implies a faster transition towards a modern society. Consumption patterns change away from food towards industrial commodities and services, as does production. Because technological development is faster in industry than in services, there is a tendency of the service share in national income to increase. Related to the fast technological change in industry, India becomes a more important net exporter of industrial commodities , and a net importer of services. With respect to agriculture, the restrictions on land and water availability, in combination with a rise in demand for foods, imply that the net imports of crops increase much more. The EU27 and Africa region benefit relatively more from rising agricultural imports by India than other regions. The rise in imports is, however, not enough to satisfy rising Indian demands for food so that the pressure on land increases, resulting in fast rising land and crop (and livestock) prices, much more so than in the rest of the world. Rising land prices lead to an intensification in the use of land. In future, rising domestic land and food prices may necessitate a more flexible import policy, agricultural investments to enable higher land productivity and, more generally, technical progress in agriculture. This may soften the impacts that a faster Indian growth has on resource scarcity, lowering food prices faced by households and increasing their consumption of food.

4 Baseline for the national CGE of India

The main aim of the India model is to investigate further the household income and demand across different income groups by rural and urban sectors. Income distributional impacts of any structural or policy changes is an important issue to be analysed. For this purpose household has been split into 3 different income groups separately for rural and urban and the factors are further divided as follows: Rural skilled and unskilled, urban skilled and unskilled, land, agricultural capital and non-agricultural capital. More details were provided in Chapter 6.

In order to be consistent with the global model, three different GDP growth scenarios, *viz.* 6%, 8% and 10% were taken up and the analysis was carried out using the same methodology. In view of the rapid transformation of the economy, it was difficult to simulate beyond 2020 scenario. Hence the analysis was done only till 2020 where the parametric changes could be perceived in numbers.

4.1 Status of the economy

India has witnessed a significant structural transformation both in agricultural production and consumption in the last decade or so. The agriculture sector, for so long the dominant sector of the Indian economy, now accounts for less than 20% of GDP, but employs over 60 per cent of the population. Even though poverty has been declining, increase in inequality has been documented in many studies.

The growth performance over the period was marked by relatively higher rates of savings, investment and improvements in many other macroeconomic indicators. Investment ratio has gone up to 34 per cent in 2006 coupled with increases in domestic and national savings. Notable increases in the external sector were also witnessed. Due to trade reforms, tariffs on consumer goods were drastically reduced as compared to tariffs on intermediate and capital goods.

The trade composition, however, shows an increasing concentration of manufactured goods and the share of food and agricultural raw materials in total exports was declining over time. In the case of imports, manufacturing accounts for slightly more than 50 percent of total imports and its share has increased over time. There has generally been a reduction in poverty over the last three decades both in the rural and urban areas. However, the reduction was significant between 1993-94 and 1999-00 which could be attributed to an increase in GDP growth. Inequality based on Gini coefficients, in both rural and urban has shown increasing trend over time.

In this backdrop, this chapter will attempt to simulate different GDP growth scenario projected for the future block years 2009-10 and 2019-20 using 2006-07 as the base year.

4.2 Sectors driving economic growth

The composition of the growth is subject to significant changes. Service sector has been steadily showing impressive growth due to increasing growth of communication, Hotels and banking. Industry sector growth is led by construction and capital intensive manufacturing. Agriculture is not only showing an average decline but also very volatile in the year to year growth.

The decadal growth rate for the period ending 2006-07 has been computed for the value added (at current prices) of the broad sectors and are reported in the Table 4.1. The economy growth is mainly driven by 4 sectors: Construction, Capital intensive manufacturing, Transport and Other Services. Agriculture and allied growth is lowest of all with food crops registering a meagre 5% annual growth at current prices.

Table 4.1 Annual Growth rate from 1997-98 to 2006-07-Value added at factor cost at current prices

Sectors	Growth rate
Food Crops	5.04
Non food crops	7.57
Dairy, poultry, Fishery and Other animal products	7.81
Primary products	11.58
Agro processing	10.53
Labour intensive manufacturing	7.58
Petro chemicals	8.90
Capital intensive manufacturing	14.42
Construction	16.76
Electricity	7.81
Transport	12.16
Other Services	13.68

It has been argued that India's reform initiatives were mainly targeted to industry However due to intersectoral linkages, benefits of reforms in trade, industry and service sectors have benefited agriculture to some extent. It has also increased agriculture exports from India. Post reforms period was also characterised by significant decline in share of public investment in agriculture. Main reason being the high level of subsidy burden and the worsening of the fiscal gap in the government budget.

4.3 Literature on growth and rural-urban income

Using the data of consumption surveys by National Sample Survey Organisation from 1951 to 1991, Ravallion and Datt (1996) have derived a new series of poverty measures for urban and rural India. The study went on to examine the impact of economic growth and sectoral composition on urban- rural poverty. It reemphasised the significant role of rural economic growth to overall poverty reduction. It was also found both rural and urban poor benefited from rural economic growth whereas urban growth not only work against poor in urban , it also has no sizable impact on rural poor. Sectoral classification of the analysis revealed that the secondary sector growth does not impact poor in both rural and urban, and growth of primary and tertiary sector in particular lead to poverty reduction in both rural and urban. The study concludes that urban economic growth fuelled by industrialisation is not going to benefit the poor. This reiterates the significance of agriculture sector growth for overall poverty reduction.

In another study, Datt and Ravallion (2007) have shown that agricultural growth did provide benefits to rural poor and the gain is mostly through wages and prices. They used the data of 24 rounds of National Sample Survey spanning 1958-94. Their results confirm that increase in the average farm yield help the poor in the form of higher agricultural wages and lower relative food prices. The study also found that the long run effects are much larger.

4.4 Model parameter assumptions

The growth rates of labour supply and population implemented in the dynamic blocks as parametric changes have been given below.

Table 4.2 Population and Labour growth rate-parameters used in the model

Pop/labour	Annual growth rate from the Base year 2006-07	
	2009-10	2019-20
Pop-rural	0.72	0.82
Pop-urban	3.91	2.38
Labour-rural	2.57	1.43
Labour-urban	3.70	2.50

Note: based on the "Report of the Technical Group on Population Projections constituted by the National Commission on Population- Population Projections for India and States 2001-2026"[1]. Capital (other than land) has a growth rate of 10% per annum, while the growth of land supply is given the very limited availability of unused land suitable for agriculture set at zero.

4.5 Simulation results

If we peruse the growth rate , the agriculture annual growth rate jumps up nearly double fold from 6% to 10% scenario in the period 2009-10 to 2019-20. Industry and services registered an impressive annual growth of 11% and 10% in the same period.

[1] *The population projection was done for rural and urban separately for each state and Union territories by the technical committee headed by Registrar General, India. The parameters considered were sex ratio at birth, fertility rate, mortality rate, and migration etc. The urban population projection was done using URGD method. This is based on the principle that rural urban growth differential follow a logistic pattern. For deriving labour participation, the parameters such as population growth in the age group 15-59 and the demography dividend were considered.*

Table 4.3 Sectoral value added in real terms -annual growth rates

Sectors	2006-07 to 2009-10			2009-10 to 2019-20		
	6%	8%	10%	6%	8%	10%
Agriculture	2.96	4.67	4.52	3.45	5.44	6.30
Industry	8.62	10.46	15.26	5.60	8.13	11.27
Services	5.61	7.80	8.92	6.90	8.62	10.14

Within agriculture sector, fruits & vegetables recorded the highest growth among major crops cultivated in 10% scenario , touching an annual growth of 4.31% between 2007-2010 in terms of real output . In 2010-20, Pulses crop has recorded highest annual growth of 6.06 % followed by cotton 5.56% in 10% scenario.

Coarse cereals recorded the lowest growth in both the periods at about 1.70 annual growth rate in 2007-10 and 2.95 in 2010-20 in the 8% growth scenario.

4.6 Comparison with the projection of other studies

Alagh(2011) made projections of agriculture and allied sector for 2020 based on the UN Alagh model . The projected foodgrains for 2020 is 225 m.t. Our model predicted above 300 m.t. even at the pessimistic 6% growth. The alternative cereal supply projections under alternative assumptions of Fertiliser use and expansion of irrigated area using partial equilibrium approach were carried out by Bhalla *et al* (1999). It reported 281 m.t. of cereal production with technical efficiency improvements. Our model has predicted very close estimate of 281.89 m.t of cereals in 2020 in the lower growth scenario of 6% GDP growth. IFPRI's model known as IMPACT used a base year of 1993 and projected 256 m.t. of cereals for 2020. Kumar (1998) projected cereal supply in 2020 using econometric approach in the partial equilibrium setting under 2 alternative scenario. The first one assumes a constant growth in TFP and the second, a declining TFP growth. His estimates were 309 m.t and 269 m.t. in the 2 scenarios. Our projection under 8% GDP growth reported 337.39 m.t. in 2020 which is higher than the Kumar's projections. Our projection is based on a General equilibrium approach and hence it includes the feedback effects of first round impact from the income accounts to the production activities in the second and the subsequent rounds.

Our results show that Pulses production growth will be very impressive between 2010-20 . It has been documented that due to change in the consumption pattern , pulses consumption per capita has been increasing gradually and this requires more production. It is to be mentioned that recently Government of India through Department of Agriculture and Cooperation has launched a project called "Accelerated Pulses Production Program" under which one million hectares of pulses area has been identified with an objective to increase the production and productivity of pulses crops. Demonstration of plant nutrient and plant protection technologies and management practices and influencing other farmers in the adjoining area to adopt these technologies are the main features of this program. Pulses area and production is expected to get a fillip due to this program. Our results are consistent with this.

Government of India launched National horticulture mission in 2005-06 with a view to boost production of vegetables and fruits. The mission has provided some fillip to this sector and the growth of fruits and vegetables in the early period 2007-10 has been very impressive, 4.3% per annum, from our simulated results in the 8% and 10% GDP growth scenario.

Table 4.4 Projected Production Volume- in million tonnes

Crops	2006-07		2009-10				2019-20		
			6%	8%	10%		6%	8%	10%
Rice	93.35		98.11	101.18	101.12		131.85	152.67	155.98
Wheat	75.8		79.9	83.48	83.36		108.53	137.02	140.51
Coarse cereals	33.92		35.1	35.67	35.66		41.51	47.7	45.11
Pulses	14.2		15.2	15.8	15.83		22.5	27.48	28.51
Fruits and Vegetables	174.55		183.77	197.88	198.11		248.41	262.60	302.11
Cotton	22.63		23.89	23.08	25.29		32.73	40.33	43.44

10% GDP growth does not favour rural due to dip in agriculture growth. Rural share has come down from 61% to 56% with GDP growth moving up from 8% to 10% . In 2019-20, even though 10% growth seems to benefit industries, it is not really benefitting rural industries. If we analyse by income groups, then 10% growth is mostly benefitting urban high income groups. This confirms that the growth is not trickling down. In particular rural bottom 2 groups' real income growth have come down from 8% to 10% GDP growth scenario during 2010-20. This is also reflected in the real income per capita figures.

Table 4.5 Rural-Urban Income Composition(%) by Household Income

HH	**2006-07**	**2009-10**				**2019-20**		
		6%	**8%**	**10%**		**6%**	**8%**	**10%**
rural1	5.65	5.63	5.49	5.26		5.46	5.47	4.60
rural2	14.79	14.36	14.48	14.23		14.92	14.89	12.87
rural3	37.70	37.97	38.01	38.24		41.22	40.84	38.95
urban1	3.18	3.08	3.03	3.12		2.46	2.43	2.78
urban2	9.80	9.47	9.50	9.80		8.16	8.26	9.38
urban3	28.89	29.49	29.49	29.34		27.78	28.10	31.42
Total	100.00	100.00	100.00	100.00		100.00	100.00	100.00
rural	58.14	57.95	57.98	57.73		61.60	61.21	56.42
urban	41.86	42.05	42.02	42.27		38.40	38.79	43.58

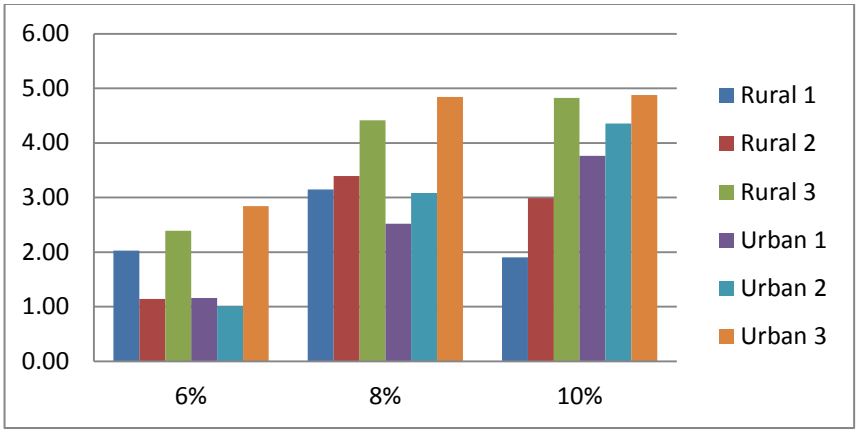
Note: Rural 1 pertain to bottom 30% of the population, Rural 2 middle 40% and rural 3 the top 30% of population. Urban counterparts follow the same criterion.

Chhibber and Palanivel (2009) have simulated results based on SAM modeling for income distribution for the year 2009-10 for pessimistic scenario against the baseline and optimistic scenario (pre global financial crisis scenario) of 8% GDP growth in both the years 2009 and 2010 . For the pessimistic (post crisis) scenario, GDP is fixed at 5.4% for 2009 and 6.5% in 2010.

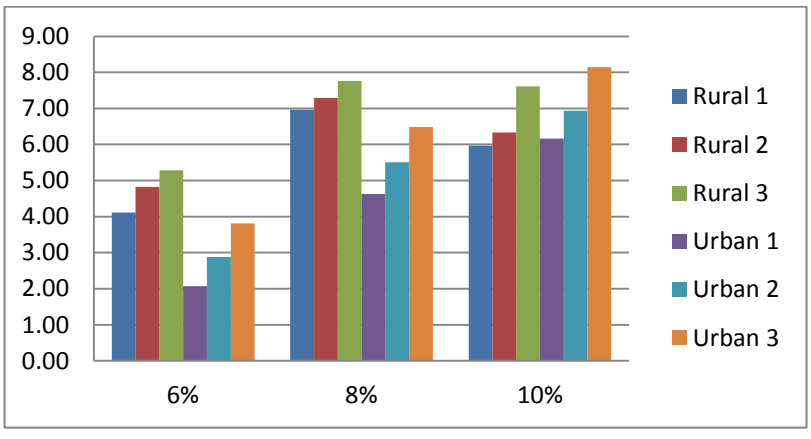
The study finds that in the period of slower growth the maximum loss is for the category middle and upper middle class of households. The difference in the growth in income for these two classes in rural from historical period to 2009-10 is 5.6 % and 4.7% respectively. However, the distribution of income does not favour 'abjectly poor' and 'poor' category in rural. Out of the total income generated in rural areas, only 2 % reaches the 'abjectly poor' and 7.5 % to the 'poor' population. Together, the low income groups in rural areas have been getting less than 10 % of the total income generated in the rural sector. Comparing this with our results, we have also found that the middle income group is losing out more in the slow growth regime from the base year to 2009-10.

Fig 4.1 Total Real Income annual Growth rates by Household Types and Income Groups-

2006-07 to 2009-10



2009-10 to 2019-20



Perusing the results on the Real annual income growth rates, it is evident that , from 8% to 10% growth regime, income is getting redistributed from rural to urban particularly in the lower and middle income groups. This is more prominent in the 2010-2020 period. Real income per capita figures further confirm this result. One can find reason in the fact that agriculture is not benefitted in the increasing GDP growth of 10%. The policies should adopt specific strategies to stimulate agriculture when the economy moves at a higher growth path. This will also help correct urban bias in the income distribution in the process of higher growth. It is also interesting to see how the income generation in the industry and services can be tapped to benefit rural by making use of sectoral linakges. In another study, Mythili and Nitin (2012) found that in the non-agriculture sectors, agro processing sector generates the highest output and income multiplier effects for agriculture. In the wake of increasing demand for processed food and change in the consumption pattern of both rural and urban, modernisation of retail chains and private entry, the promotion of agro processing would certainly help agriculture by increasing forward linkage of agriculture with this sector. It was also found that a unit exogenous expenditure in the agro processing sector among the non-agriculture sectors, generates highest income to rural areas.

Table 4.6 Real Income per Capita – Annual income in rupees (₹)

HH	**2006-07**		**2009-10**				**2019-20**		
			6%	8%	10%		6%	8%	10%
rural1	8412		8743	9035	8713		12024	16274	14298
rural2	16531		16739	17882	17675		24645	33214	30022
rural3	56172		59013	62585	63326		90784	121446	121131
urban1	12170		11228	11689	12118		11389	15191	18206
Urban2	28149		25857	27481	28515		28386	38819	46081
urban3	110696		107328	113693	113811		128874	176012	205829

Table 4.7 Annual growth rates of Total Consumption at current prices

HH	2006-07 to 2009-10			2009-10 to 2019-20		
	6%	8%	10%	6%	8%	10%
rural 1	5.75	6.72	5.72	5.02	5.87	5.25
rural 2	7.23	8.30	7.12	5.96	6.85	6.25
rural 3	9.26	9.94	9.04	6.29	7.63	7.7
urban 1	4.67	5.38	5.5	2.94	4.85	5.84
urban 2	5.88	6.52	6.68	3.52	5.66	6.79
urban 3	8.29	8.66	8.86	4.46	6.97	8.3

Table 4.8 Current Consumption per Capita – Annual consumption in ₹

HH	2006-07		2009-10				2019-20		
			6%	8%	10%		6%	8%	10%
rural1	8923		10328	10615	10317		15493	17260	15820
rural2	14109		17026	17542	16972		27913	31277	28595
rural3	30693		39176	39924	38951		66268	76557	75116
urban1	12659		12942	13205	13251		14294	17524	19319
urban2	23505		24872	25322	25438		29051	36314	40549
urban3	58376		66078	66758	67116		84497	108202	123157

Table 4.9 Demand Projection for foodgrains - 8% GDP growth scenario

Foodgrains/cereals	2006-07	Projection - 2009-10	Projection- 2019-20
Total demand (million tons)			
Foodgrains	222	238.01	342.19
Cereals	206	220.70	310.05
Annual Per Capita Demand (in kgs.)			
Foodgrains	196	200.63	256.45
Cereals	182	186.04	232.36

Note: Foodgrain includes cereals and pulses.

Bhalla et al. (1999) has projected cereal demand for 2020 under alternative scenarios of income growth . With 6% per capita income growth the Bhalla estimates for 2020 is 267.2 million tonnes which is considerably less than our projections in the 8% GDP growth scenario. The annual per capita demand for cereals is estimated at 201.84 kgs. in Bhalla *et al.* against our estimates of 232.36 kgs. Mittal ..(2006) has projected foodgrain demand assuming 8% GDP growth for 2010 and 2020 as 199.6 and 255.8 m.t. This study used 1999 NSS household survey expenditure elasticities and used 2000 as the base year. Our study used 2006-07 as the base year and 2004-05 NSS expenditure elasticities and the projected figures for the respective years are 238 and 342 m.t. Kumar (2011) has projected 2020 level of 249.06 m.t.for cereals and 268.34 m.t. for food grains. The projected figures for 2010 are 216.46 m.t. and 233.1 m.t. respectively for cereals and foodgrains. Our cereal projections are 220 m.t. and 310 m.t. respectively for 2010 and 2020.

The demand for foodgrains and cereals by rural and urban for different income groups and the per capita demand are given in the Tables 4.10 and 4.11 respectively.

Table 4.10 Total Demand Projections- Annual percentage change - 8% GDP growth scenario

HH	Cereals			Foodgrains		
	2006-07 (1000 tons)	2009-10 % change	2019-20 % change	2006-07 (1000 tons)	2009-10 % change	2019-20 % change
Rural 1	31579	1.49	4.37	33238	1.57	4.56
Rural 2	54180	1.53	3.49	57597	1.66	3.70
Rural 3	71535	2.19	3.45	77611	2.44	3.79
Rural Total	157294	1.71	3.74	168446	1.88	3.97
Urban 1	15403	4.50	1.95	16564	3.72	2.30
Urban 2	12068	4.15	2.97	13072	3.79	3.23
Urban 3	21081	4.51	2.68	23654	4.48	2.85
Urban Total	48552	4.36	2.58	53289	3.98	2.84

Going by the demand projection estimates, rural consumption has improved between 2010-20 in cereals and foodgrains. We have earlier noted that the real income per capita has substantially improved for the rural between 2010-20. One reason could be the falling population growth and migration from rural to urban. The other reason might be the larger growth of real wages for rural unskilled and the resultant increase in the consumption.

Table 4.11 Annual Per capita demand in Kgs.- 8% GDP growth scenario

HH	Cereals			Foodgrains		
	2006-07	2009-10 projection	2019-20 projection	2006-07	2009-10 projection	2019-20 projection
Rural 1	129.38	132.37	186.46	136.17	139.66	200.36
Rural 2	166.48	170.50	220.77	176.98	181.99	240.41
Rural 3	293.08	306.06	394.81	317.97	334.57	445. 85
Rural Total	193.33	199.09	264.03	207.03	214.25	290.57
Urban 1	162.26	165.04	165.51	174.50	173.53	179.95
Urban 2	95.35	96.02	106.34	103.28	102.92	116.92
Urban 3	222.09	225.94	243.14	249.19	253.33	277.19
Urban Total	153.45	155.46	165.67	168.42	168.73	184.59

4.7 Conclusion

We could conclude that 10% GDP growth does not favour rural due to dip in agriculture growth. Rural share has come down from 61% to 56% with GDP growth moving up from 8% to 10% . In 2019-20, even though 10% growth seem to benefit industries and services, it is not really benefitting rural industries. If we analyse by income groups, then 10% growth is mostly benefitting urban high income groups. This confirms that the growth is not trickling down. In particular rural bottom 2 groups' real income growth have come down from 8% to 10% GDP growth scenario during 2010-20. This is also reflected in the real income per capita figures.

A major policy implication drawn from the study is 'how to improve agriculture in the higher GDP growth scenario?' Also supplementary measures are needed to tackle dipping rural poor income with increasing growth.

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