How pro-poor are productivity gains in agriculture? The case of the national agricultural investment plan of Benin

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Abstract

This study conducts an ex-ante assessment of the effects of the agricultural productivity and production objectives under the Beninese agricultural investment plan (PNIASAN) from 2017 to 2021 on different sectors and the economy of Benin as a whole. A dynamic Computable General Equilibrium model is used for the analysis, building on a comprehensive Social Accounting Matrix. Impacts of the PNIASAN are compared to a Business as Usual (BAU) scenario, for which a continuation of historical growth rates is assumed.

Under the PNIASAN, the total agricultural production quantity is 17% higher in 2021 and the average agricultural price level is 15% lower compared to the BAU scenario. Due to this, consumption of food is 11% higher. In 2021, GDP is 5% higher than under the BAU scenario. All household groups experience welfare benefits from implementing the PNIASAN, though to a different extent. Low-income households benefit more from the declined food prices in relative terms, as their food expenditure share is higher than for richer households. On the income side, all households except the poorest rural and urban income quintiles benefit, and the higher their income, the more households benefit in rural as well as in urban areas due to the composition of their factor income.

In conclusion, the productivity and land targets implied by the PNIASAN make the economy of Benin better off. Their achievement, however, is not automatically pro-poor: with respect to income, richer households benefit more than poorer households and the poorest rural households even experience an income loss, although they derive substantial welfare gains from the expenditure side as food prices decline resulting in a positive net welfare gain. This implies the need for an implementation of the measures specified in the plan that targets the poor as well as for complementary policies, if the government of Benin intends this plan or future plans on agricultural development to be pro-poor.

Keywords:

pro-poor growth, CGE, general equilibrium, total factor productivity, income distribution, agricultural development, agricultural policy, agriculture, impact analysis

1 Background

It is often proclaimed that investments in agriculture in developing countries leading to higher productivity stimulate economic growth and alleviate poverty as agricultural production rises and prices of staple foods drop (Breisinger et al. 2011). Indeed, increased and more efficient agricultural production allows consumers to profit from lower food prices. But improvements in productivity may have adverse implications for producers, depending on the extent to which cost reductions compensate for the decline in output prices (Evenson and Gollin 2003; Cochrane 1958). Thus, improvements in agricultural productivity may lead to declining prices of production factors, which become relatively more productive (land, unskilled labor) and to a more inequal income distribution between rural and urban areas as well as between poor and rich, given that often the poor derive a higher share of their income from agriculture. This may cause income distribution to be more unequal and relative poverty to increase, which has several negative implications such as social exclusion and impeding further growth as pointed out by Duclos (2009). The aim of this study is to analyze the distributive effects of increases in agricultural productivity as well as options to make such increases more pro-poor, taking Benin as an example.

2 The agricultural investment plan in Benin

Between 1992 and 2016, agriculture contributed on average to 26% of the Beninese GDP and employed about 48% of the labor (World Bank 2019a). These figures show the relatively low productivity of the sector and its potentially strong contribution to the growth of the Beninese economy.

To foster the development of the agricultural sector, an investment plan was issued by the Beninese government for the period from 2017 to 2021 (Plan National d'Investissements Agricoles et de Sécurité Alimentaire et Nutritionnelle - PNIASAN). The overall aim of the PNIASAN is to boost agricultural productivity and by this generate inclusive growth and reduce poverty. Specific productivity targets are formulated for 13 priority sectors. These shall be reached by providing better access to agricultural inputs, provision of training and extension services, improved infrastructure, including rural roads and irrigation schemes as well as mechanization.

The total cost of the PNIASAN is estimated at 1,569.7 billion CFAF (2.7 billion USD).This is equivalent to about 140 USD annually per hectare or to about 6% of GDP. The government is projected to fund 56% of this plan from the national budget and about 43% is expected to be contributed by the private sector (MAEP 2017). On an annual basis, this means that the government budget for the agricultural sector would need to grow by more than 66%.

3 Modelling approach

A single country dynamic Computable General Equilibrium (CGE) model based on Diao and Thurlow (2012) is used to analyze the implications of the PNIASAN in an economy-wide context. The model allows representing the stepwise implementation of the PNIASAN over its five-year period as well as the analysis of long-run effects occurring after the PNIASAN has phased out.

The model is set up as follows: Capital accumulation is modeled using a "putty-clay" formulation. Thus only new capital can be distributed over activities, while once invested it

remains activity specific. Other production factors (arable land, skilled and unskilled labor) are assumed to be fully employed and mobile across sectors, whereby land is only used in cropping activities. The assumption of full employment of labor is consistent with the observation that in Benin, while not many people have formal jobs, most working-age people engage in activities that contribute to GDP. A Linear Expenditure System is employed to depict household consumption including considerable shares of subsistence consumption. Following the small country assumption, world market prices are set to be fixed. With Benin being a relatively small economy in the CFA franc currency union and its currency being pegged to the Euro, the exchange rate is fixed as well, making it the numéraire, while allowing the CPI to adjust (van der Mensbrugghe 2013). Domestic savings are assumed to be investment driven, with the latter being a fixed share of total absorption, while foreign savings are assumed to be unaffected by domestic policy changes and hence fixed.

We apply this model to a detailed SAM of Benin for the year 2015. The SAM comprises of 105 accounts including 38 production sectors (17 agricultural), 10 household groups (rural and urban quintiles) and several tax-accounts. The SAM is complemented with additional data projections on growth rates of GDP, labor force, arable land, sectoral productivity, remittances and foreign aid (IMF 2019; United Nations 2019; World Bank 2019b). These data are used to create a baseline (BAU- business as usual) until 2030, which provides a counterfactual scenario for comparison with the PNIASAN scenario.

4 Implementation of the PNIASAN

This study does not assess, whether the productivity targets set in the plan can be fulfilled with the measures and the budget foreseen, but instead analyses, what the potential impacts of the fulfillment of the targets on the overall economy of Benin would be. The projected productivity improvements of the PINASAN are implemented as stepwise shocks in total factor productivity in the respective agricultural sectors over the five years period of the plan. On top, the productivity and production targets of the PNIASAN imply an increase of agricultural area by annually 2.4% over five years, which is implemented as an increase of factor supply.

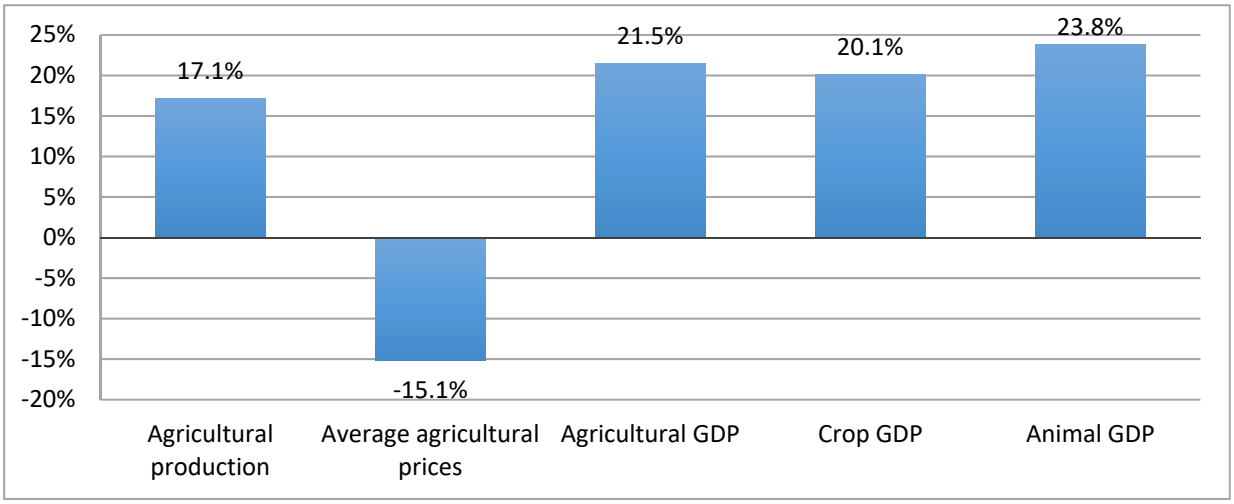
As described, the productivity targets are to be achieved mainly through investments in education and training, infrastructure and machines. This is depicted in the model by exogenously increasing government savings and consumption, triggering increased investment in construction of infrastructure and machinery as well as demand for education. In order to maintain the government's budget balanced, different tax instruments endogenously adjust. These are in the first scenario the sales tax, which is levied on most commodities in Benin and in the second scenario the income tax, which has a much smaller base, as in Benin it is only levied on formal wages and collected from wealthier households.

5 Results

5.1 Agricultural production and prices

Under the PNIASAN, the productivity of production factors in agriculture as well as the endowment with production factors (land) increases. Therefore, total agricultural production quantity is 17% higher in 2021 under the PNIASAN. The average agricultural price level is 15% lower compared to the BAU scenario (Figure 1).

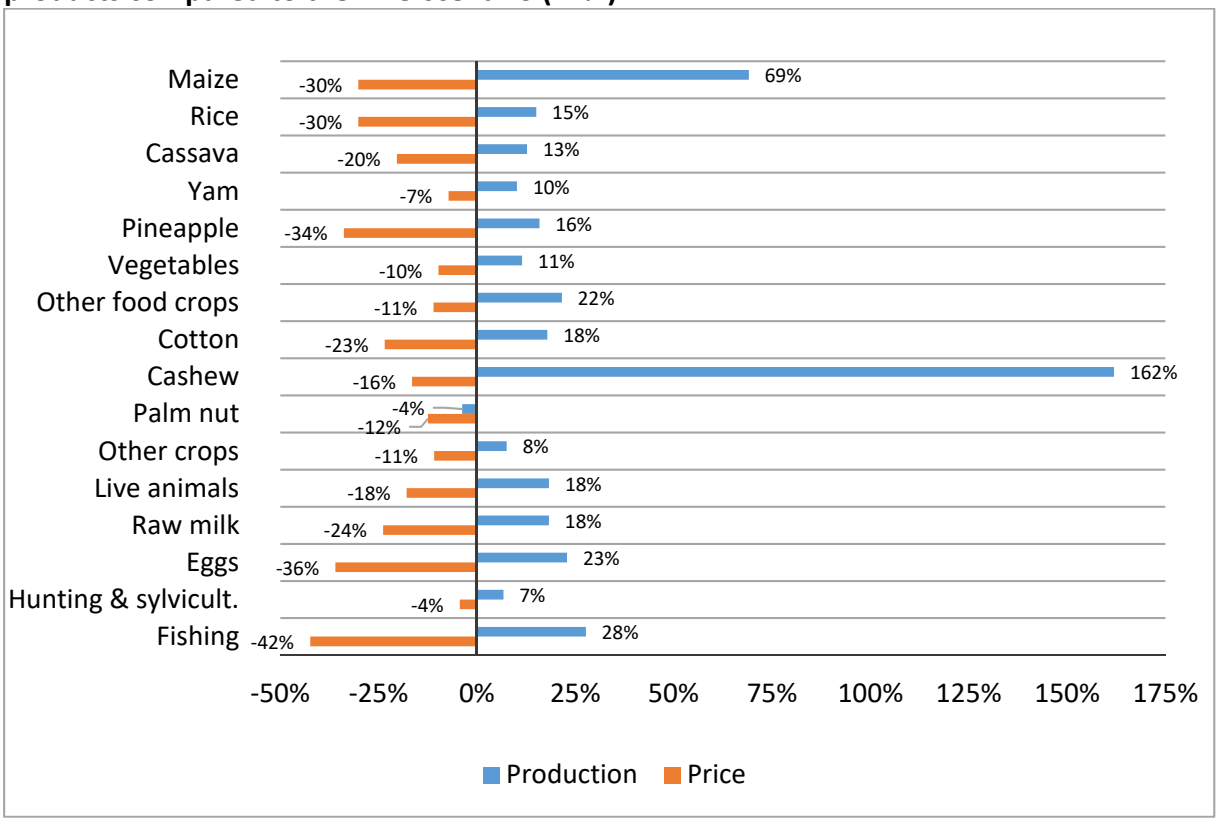
Figure 1: Effects of the PNIASAN in 2021 on agricultural production, price level and GDP as well as crop and animal production GDP (at constant prices) compared to the BAU scenario in 2021 (in %)



Source: Own calculations.

Looking at the agricultural sector in more detail, Figure 2 shows the changes in production as well as prices per agricultural product compared to the baseline.

Figure 2: Effects of the PNIASAN in 2021 on production quantities and prices of agricultural products compared to the BAU scenario (in %)



Source: Own calculations.

Production under the PNIASAN compared to the BAU scenario is especially higher for cashew (162%) and for maize (69%). This is the result of a wide range of drivers, among which productivity growth rates (Table 1), the increase in agricultural land and the model endogenous allocation of that land to different crops. Furthermore, the responsiveness of

domestic demand as well as international demand and supply and the trade shares are important determinants, resulting in different price responses to productivity shocks. Cashew and maize are the two products with the highest export shares in total production (62% and 27%, respectively). This allows to increase production substantially without depressing domestic prices too much, especially in light of the high transformation elasticities between production for export and production for the domestic market (Annex Table 7). For some products, production increases are relatively small, accompanied by strongly decreasing prices. This is the case for pineapples and for rice and results from the fact that these products have very small export shares in the base situation, which does not allow for substantial additional exports under the simulations and thus increasing domestic supply is restricted by inelastic domestic demand, leading to falling prices.Consumption and trade

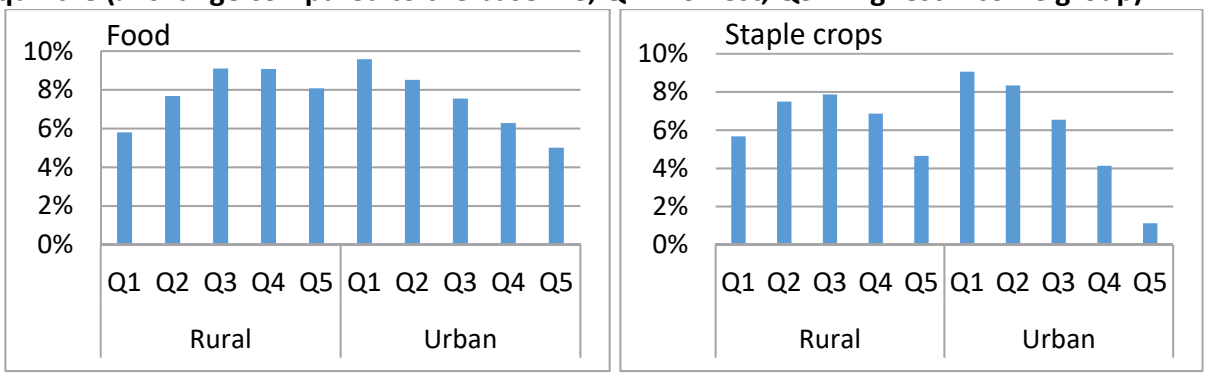
Due to lower agricultural and food prices, consumption of food is 11% higher and exports of agricultural and food products are 129% higher. In addition, increasing domestic production leads to a substitution of imports and overall agricultural imports are 18% lower than in the BAU scenario. Table 1 shows the changes in consumption as well as export and import quantities for individual products compared to the baseline. Effects on exports are especially strong e.g. for pineapple, cashew and maize.

Table 1: Effects of the PNIASAN on consumption, export and import quantities of agricultural and food products compared to the BAU scenario (in %)

Products	Household consumption in 2021 relative to the BAU (%)													Trade in 2021 relative to the BAU (%)	
	Rural households						Urban households								
	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	All	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	All	Total	Export	Import
Maize	7.09	9.10	9.30	8.06	5.47	7.99	10.62	9.85	7.72	4.85	1.30	3.95	5.91	249.16	
Rice	17.69	19.48	18.93	16.32	11.13	16.88	22.39	20.18	16.07	10.29	2.79	8.74	13.45		
Cassava	8.39	10.36	10.47	9.05	6.15	9.05	12.08	11.11	8.72	5.50	1.47	4.55	7.11		
Yam	1.38	3.69	4.40	3.94	2.74	3.53	4.37	4.48	3.50	2.19	0.59	1.84	2.80	48.06	
Pineapple	18.07	21.09	22.22	21.66	18.93	20.71	22.90	21.83	18.81	14.67	9.53	13.66	17.74	424.00	
Fresh vegetables and spices	2.27	5.28	6.63	6.72	6.05	5.99	5.82	6.22	5.37	4.18	2.78	3.76	5.01	40.46	-19.78
Other food crops for local consumption	2.86	5.56	6.75	6.77	5.98	5.95	6.19	6.38	5.44	4.14	2.68	3.78	5.00	46.36	-20.46
Other food crops for export	1.62	4.38	5.62	5.70	5.08	4.80	4.91	5.24	4.48	3.42	2.23	3.15	4.09	58.99	-11.61
Cashew	15.50	18.41	19.44	18.92	16.43	18.56	20.29	18.79	16.10	12.61	8.06	8.96	15.37	360.02	
Palm nut	4.94	7.66	8.83	8.76	7.69	7.86	8.49	8.46	7.21	5.56	3.56	5.14	6.89		
Other crops for industry or export	4.45	7.25	8.46	8.43	7.44	7.53	7.98	8.07	6.92	5.32	3.46	4.94	6.60	57.45	
Live animals and poultry	14.13	18.19	19.25	17.78	14.01	17.15	19.69	19.49	16.96	13.17	8.17	12.01	14.88	143.06	
Raw milk	19.40	22.39	22.91	21.25	17.02	20.90	24.70	23.82	21.04	17.06	12.22	15.93	18.82		
Eggs and other husbandry activities	35.05	38.75	38.67	35.04	27.04	35.30	41.93	39.83	34.45	26.53	16.11	23.80	30.18		
Hunting and sylviculture	2.21	5.46	6.73	6.51	5.38	5.62	6.12	6.67	5.87	4.73	3.45	4.44	5.09	23.77	
Fishing products	45.47	50.33	51.00	47.70	39.31	47.42	53.17	51.85	46.77	38.45	25.67	35.70	42.49	276.13	-77.18
All food	**12.70**	**13.90**	**14.56**	**13.45**	**10.47**	**13.18**	**17.18**	**15.17**	**12.87**	**9.67**	**5.60**	**8.70**	**11.22**	**129.41**	**-18.16**
All agricultural products	**12.05**	**13.48**	**14.17**	**13.11**	**10.23**	**12.80**	**16.49**	**14.72**	**12.50**	**9.41**	**5.49**	**8.47**	**10.91**	**97.76**	**-17.71**

Source: Own calculations.

Figure 3: Effects of the PNIASAN on food and staple food consumption per household quintile (% change compared to the baseline; Q1 = lowest, Q5 = highest income group)



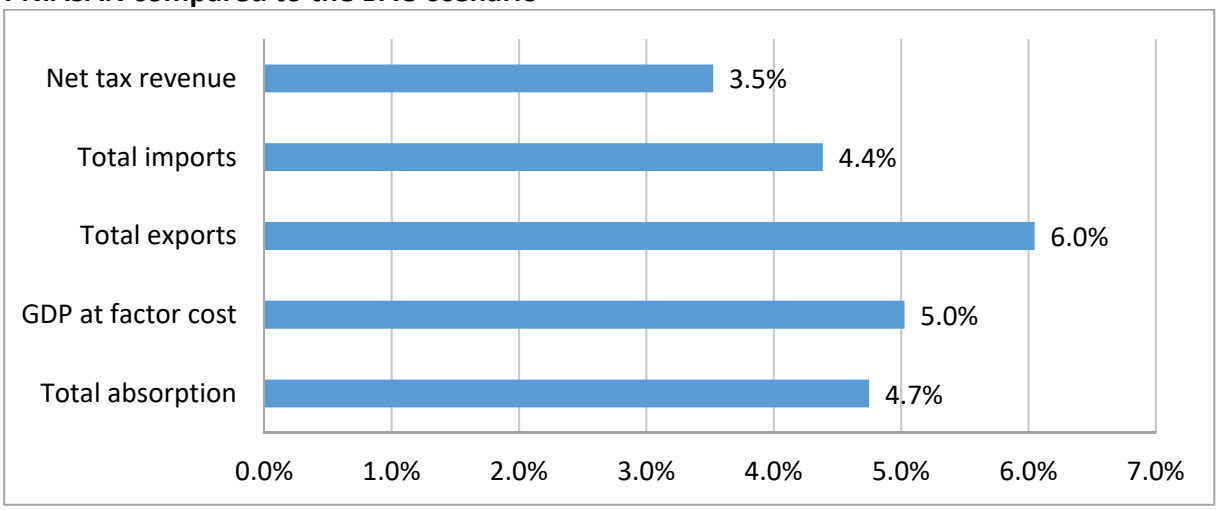
Source: Own calculations.

Figure 3 shows that globally, all household groups increase their total food, as well as their staple crop consumption under the PNIASAN relative to the BAU scenario. For total food, this increase ranges from about 5% for the richest urban household quintile to almost 10% for poorest urban household quintile. For urban households, the poorest quintile increases food consumption most (almost 10%) and the richest least (about 5%). The same pattern applies to urban household groups for staple crops consumption. This is due to poor households being more price responsive (prices are falling) and income responsive (income is increasing see below). For rural household groups, however, the middle-income quintile is the one, which will increase its staple crop consumption most. This results from two opposing effects working in different directions: poor households are more price responsive, but at the same time, their income declines, while that for higher income rural household groups increases.

5.2 Macroeconomic effects

The developments in the agricultural sector caused by the productivity and land shocks have repercussions in the economy as a whole, as agriculture is a large sector in Benin (Figure 4).

Figure 4: Percentage change of selected macroeconomic indicators in 2021 under the PNIASAN compared to the BAU scenario



Source: Own calculations.

- GDP ant total absorption grow annually by about 1% more and in 2021, as a cumulative effect both measures are about 5% higher than under the BAU scenario.

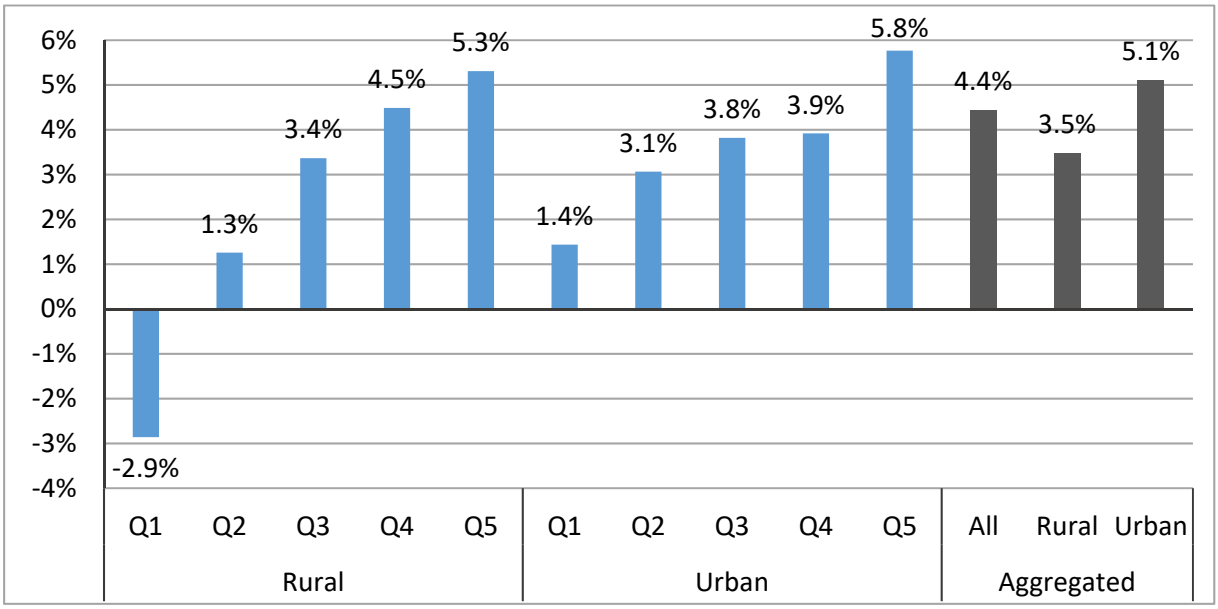
- This stems from increasing productivity of production factors as well as an increasing factor stock (land). Furthermore, lower agricultural and food prices contribute to the purchasing power of consumers who spend more on consumption of other products and such generate multiplier effects throughout the economy.
- Total imports and total exports both increase by the same absolute amount, which is a consequence of the model closure chosen (see Section 3.2). There are, however, differences in percentage changes, as there is a trade deficit in the model base period (imports a larger in absolute terms than exports), which is assumed to stay constant.

5.3 Welfare and distributional effects

The PNIASAN affects private households directly in two ways: First, lower agricultural and food prices have an effect on the expenditure side of households and second, changes in prices for production factors as well as taxes raised to fund the PNIASAN affect private household income. Looking at the expenditure side, poorer households benefit more from the declined food prices in relative terms, as their food expenditure share is higher than for richer households. This is reflected by the relatively strong increases in food expenditures of poor households (Figure 3), despite their lower income increases (Figure 5).

On the income side, all households apart from the lowest rural income quintile benefit, but high-income households generally benefit more than low-income households (Figure 3). In addition, urban households benefit more proportionally than rural households.

Figure 5: Household income effects of the PNIASAN in 2021 compared to the BAU scenario in 2021 in % (Q1 = poorest income group; Q5 = highest income group)



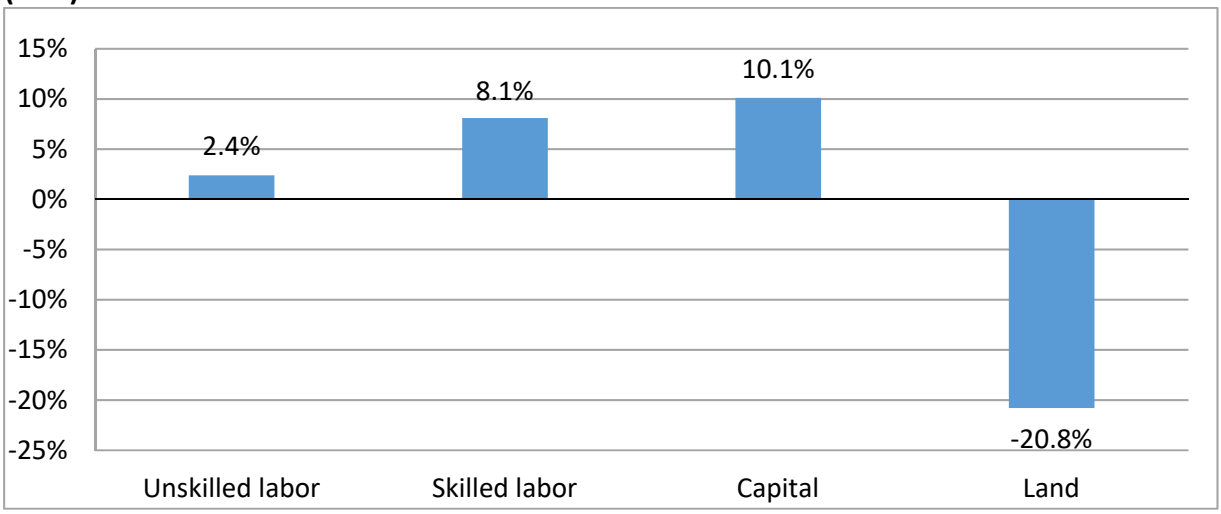
Source: Own calculations.

This can be explained by the development of factor prices (Figure 6):

- The wage for skilled labor and capital rents increase the most, while the wage for unskilled labor increases to a lesser extent. Thus, richer households benefit more, as their share of income from skilled labor and capital is higher.

- The factor price for land (which can be interpreted as the rental rate) declines by almost 21%. Thus, income of most rural household groups increases less than income of urban households, as rural households have a higher income share from land. For all rural household groups on average, the share of land in total factor income is 11%, for the lowest rural income quintile it is 46% and for the highest income quintile it is 3%.
- In conclusion, the negative income effect for the lowest rural income quintile is strongly driven by its high share of income from land and would not apply for landless rural households such as agricultural workers.

Figure 6: Development of factor prices under the PNIASAN compared to the BAU scenario (in %)



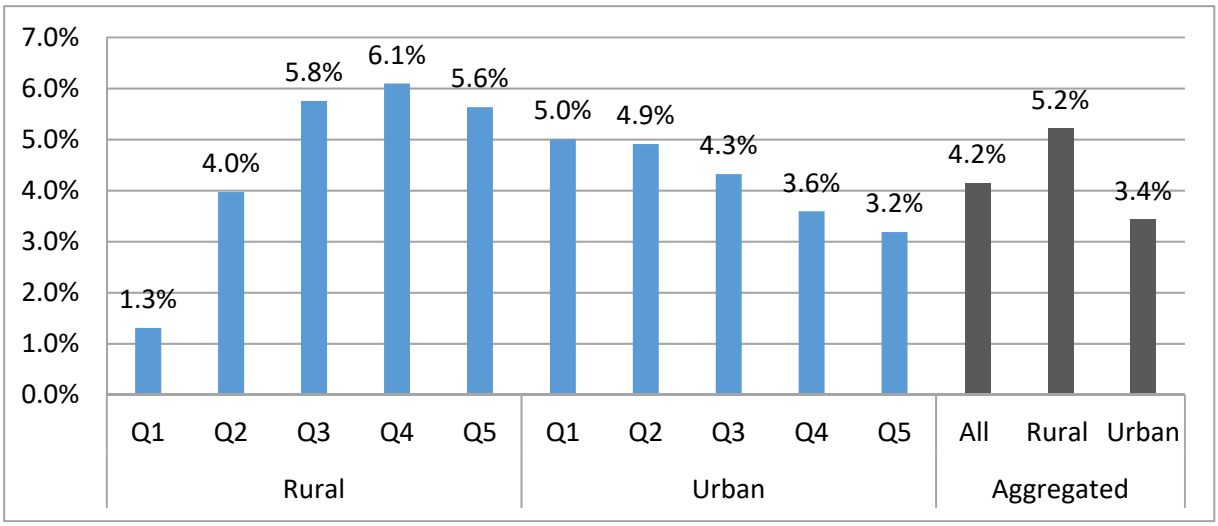
Source: Own calculations.

The development of factor prices may seem counterintuitive at first sight. It follows, however, logically from the effect of the PNIASAN: by increasing the productivity of agriculture, factors which are overproportionally employed in agriculture become relatively less scarce: unskilled labor and land. Furthermore, land is getting even less scarce, as agricultural area expands. Therefore, the production factors, which are employed less than proportionally in agriculture, capital and skilled labor, are getting relatively scarcer and thus more expensive.

The combination of the pro-poor welfare effects resulting from lower food prices and the non-pro-poor welfare effects resulting from changes in factor income combine in a way that all household groups experience substantial welfare gains which vary between 1.3% (lowest rural income quintile) and 6.1% (fourth rural income quintile) of the 2021 BAU income (Figure 7). In total, private household welfare gains are about 4.2% of income under the BAU scenario in 2021. These overall effects are more positive in rural areas (5.2%) than urban areas (3.4%). However, welfare effects in 2021 are non-pro-poor in rural areas and pro-poor in urban areas. In rural areas, households have a higher share of their expenditures on food (including subsistence production) and thus benefit more from lower food prices. But as the poor are more negatively affected at their income side due to their relatively low income shares from capital and skilled labor and their high income shares from unskilled labor and land, they benefit less in total. For urban households, high-income households benefit less than low-income households due to their lower expenditure shares on food and due to the fact, that

we assume the cost of the PNIASAN being covered to a large extent by direct taxes predominantly charged on high income households.

Figure 7: Household welfare effects* of the PNIASAN in 2021 in % of the BAU income in 2021 (Q1 = lowest income group; Q5 = highest income group)



* Measured as equivalent variation in percent of baseline income in the year 2021.

Source: Own calculations.

5.3.1 Effects up to 2030

Once, the additional productivity and area shocks are ended in 2021 and the tax rates as well as area and productivity growth rates return to their baseline levels, the positive effects on agriculture and the economy as a whole persist to a substantial degree. For example, while total GDP is about 5.0% higher under the PNIASAN scenario compared to the baseline in 2021, it is still 4.3% higher in the year 2030. Agricultural GDP in real terms (measured in constant input and output prices of the base period) remains at about 21% above the baseline level in 2021 as well as in 2030.

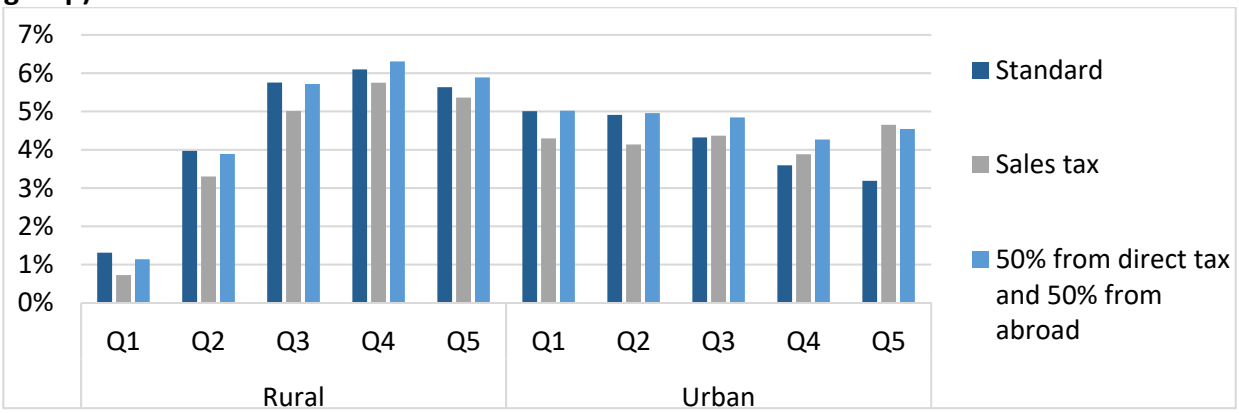
5.4 Sensitivity analyses

Alternative funding options.

Figure 8 compares the welfare effects of the PNIASAN under different funding options. Under the sales tax scenario, the welfare gains of most households are slightly reduced compared to the income tax scenario (Standard). This stems from the fact that in the sales tax scenario, all households contribute to financing the PNIASAN. Thereby, a higher burden is put on poor households who spend a relatively higher share of their income on consumption instead of saving. An exemption are the urban quintiles 3, 4 and 5 who are paying the lion's share of income tax in the standard scenario and which in the sales-tax scenario contribute a relatively lower share to the total financing of the PNIASAN.

The funding of 50% of the PNIASAN by international donors has similar welfare implications as in the standard scenario for most household groups. Those households (rural quintiles 4 and 5 and urban quintiles 3-5) who are paying income tax are slightly better off, as their tax-burden is reduced and thus their disposable income increases.

Figure 8: Household welfare effects* of the PNIASAN in 2021 in % of the BAU income in 2021 under three different funding options (Q1 = lowest income group; Q5 = highest income group)



* Measured as equivalent variation in percent of baseline income in the year 2021.

Source: Own calculations.

No increase in land supply

Increasing agricultural land use in Benin is controversially discussed for at least two reasons:

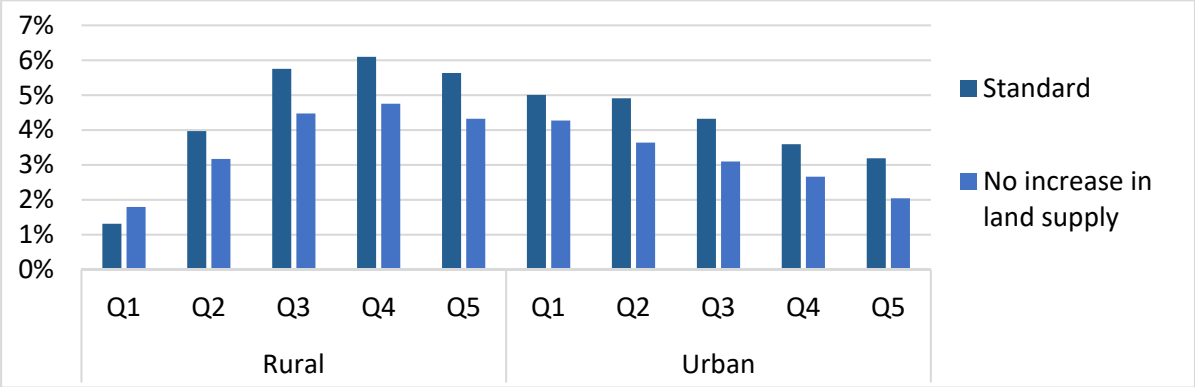
- Land is owned by families who may not want to rent out or sell land, even if they do not use this land for farming. In such cases, options for the government to encourage land use are perceived as limited.
- Environmental externalities may be caused by increasing land use.

Therefore, a sensitivity analysis was applied in order to assess the productivity effects envisaged under the PNIASAN without an increase in land supply. As expected, effects on agricultural production are slightly less in this case: Instead of 16.9%/17.4%/21.5%, domestic agricultural/crop/animal supply are only 12.9%/12.5%/19.3% higher compared to the baseline in 2021. Accordingly, also the welfare effects are substantially lower for most household groups.

Figure 9 shows the welfare effects of the productivity shocks per household group with (standard scenario) and without (sensitivity analysis) increasing land supply.

It can be seen that without an additional increase in land supply welfare effects for all households except for the rural poor (Q1) are less. This is because as less land is available, overall domestic production does not increase as much as in the standard scenario, which is why household income is not as high as in the core scenario. While income from production factors generally is lower compared to the standard setup, only income from land is declining less strong (-6.9% vs -11.1%), as land is a scarcer production factor if its supply is not increased so that the land rent drops only by 6.9% instead of 20.8%. Of all household groups, the poorest rural quintile derives the largest share of their income from land, which is why in case of less increasing land supply their income drops slightly less than under the standard scenario and the positive effect of reduced consumer prices dominates more.

Figure 9: Household welfare effects* of the PNIASAN in 2021 in % of the BAU income in 2021 with and without increase in land supply (Q1 = lowest income group; Q5 = highest income group)



* Measured as equivalent variation in percent of baseline income in the year 2021.

Source: Own calculations.

6 Conclusions

6.1 On the PNIASAN

- The PNIASAN is an ambitious plan, targeting at high growth rates for crop and animal productivity and production.
- This study does not assess, whether the targets set in the plan can be fulfilled with the measures and the budget foreseen, but instead analyses, what the potential impacts of the fulfillment of the targets on the overall economy of Benin would be.
- Especially two aspects of the plan were not assessed critically for this study:
  - It is not clear, to what extent the share of 44% in the total budget foreseen to be paid by the private sector will be realized.
  - For some crops, the targets set regarding yields seem very high if contrasted with the yield developments of the last 15 years. This is the case e.g. for cotton and cashew. For animal production, the targets are far beyond the historical trend except for beef.
- For crops, the plan specifies targets for yield and production increases. The production growth rates are higher than the yield growth rates for all crops except for cashew.
  - This implies an increase in arable area by 330,000 hectares, equivalent to 11.7% of current arable land.
- The plan specifies an overall increase in animal production by 60%. Even in case of improving feed efficiency by e.g. 10% over the implementation period of the plan and about 15% of additional feed demand being covered by imports, this would require substantially more land for the production of animal feed. We estimate this demand at 4.5% of total agricultural area.
- In total, the additional agricultural area demand is estimated at 12.4% of the agricultural area in the year 2013. This would imply ambitious annual growth rates which are higher than those, historically observed.

- A thorough assessment is needed, of what the environmental effects of this extent of additional land use would be and what complementary measures would be needed, to not reduce the environmental sustainability of agricultural production in Benin.

6.2 On the data situation for the analysis with economy wide simulation models

- Economy wide simulation models need comprehensive databases, called Social Accounting Matrices (SAMs).
- The quality of the database in terms of correctness, comprehensiveness and degree of differentiation in various dimensions (products, households, production factors) to a large extent determines the options for, as well as the quality of simulation model analyses.
- Existing Social Accounting Matrices for Benin are not disaggregated enough (2013 INSAE SAM, 2015 SAM by an external consultant) to exploit the analytical potential of CGE models for Benin fully, especially with regard to household differentiation.
- Most of the data which would be needed to build a richer and recent Social Accounting Matrix is collected by INSAE and some of this data was used to disaggregate the 2015 SAM for the analysis in this project.
- The bottleneck for a better SAM is thus not the general data availability, but the resources available to analyze and process this data.
- It seems adequate, that the core work for the construction of a SAM takes place at INSAE, as this is the institution with the best knowledge on the data.
- INSAE is currently working on the compilation of a SAM for the year 2015.
- In order to support more in-depth impact analysis of agricultural as well as economic policies, it would be desirable, to strengthen INSAE in this field through capacity building as well as the provision of resources for a team within INSAE working on a SAM.

6.3 On the effects of the achievements of the productivity targets of the PNIASAN

6.3.1 How we analyze the effects of the productivity targets of the PNIASAN

- We simulate the effects of achieving the PNIASAN targets with a so-called Dynamic Computable General Equilibrium (CGE) model.
- The CGE model is a mathematical depiction of the economy of Benin: It serves as a “laboratory”, allowing to analyze how the economy of Benin would react to certain exogenous changes, such as for example the implementation of new policies.
- We use the CGE model to compare two situations (scenarios):
  - A “Business as Usual” (BAU) situation, for which we assume a continuation of historical growth rates for GDP, population, productivity, land and animal stocks, but no implementation of the PNIASAN.

- A situation with all the elements of the BAU scenario, but in addition the implementation of the PNIASAN over the period 2017-2021.

- The following elements of the PNIASAN are depicted in our model:
  - Productivity changes for crops as envisaged in the PNIASAN, compared to productivity changes in the BAU scenario are implemented as increases in total factor productivity of the respective sectors.
  - Production changes for animal products envisaged in the PNIASAN compared to productivity changes in the BAU scenario are implemented as increases in total factor productivity of the respective sectors.
  - An increase of agricultural land implicit in the production targets in the PNIASAN, compared to an increase of agricultural land under the BAU scenario (BAU: 5.5%, PNIASAN: + 12.4%).
  - An increase in the public budget for agriculture by 319 Billion 2015 CFAF. In order to keep other expenditures constant, we increase income taxes for private households in relative terms such as to fund the additional expenditures. Income taxes in Benin are mainly paid by the three upper urban income quintiles and their income tax rates rise by 3.3 percentage points at maximum.

6.3.2 The results of the productivity targets of the PNIASAN

- Under the PNIASAN, total agricultural production quantity is 17% higher in 2021 and the average agricultural price level is 15% lower compared to the BAU scenario.

- Due to lower agricultural and food prices, consumption of food is 11% higher, imports of agricultural products are 18% lower and exports of agricultural and food products are 129% higher.

- As a result, agricultural GDP in real terms (measured in constant input and output prices of the base period) is about 21% higher than under the BAU scenario.

- GDP grows annually by about 1% more, and as a cumulative effect in 2021, GDP is 5% higher than under the BAU scenario.

- Total absorption of private as well as public institutions is 4.7% higher in 2021 than under the BAU scenario and welfare of the population of Benin is about 4.4% higher than in the BAU scenario in 2021.

- These effects to a large extent persist in the longer run, beyond the phasing out of PNIASAN.

- Looking at the distributional results, we find that:
  - Poorer households benefit more from the declined food prices in relative terms, as their food expenditure share is higher than for richer households.

- On the income side, all households except the poorest rural income quintile benefit, and the higher their income, the more households benefit in rural as well as in urban areas.

- This can be explained by the development of factor prices:
  - The wage for skilled labor and capital rents increase substantially, but the wage for unskilled labor increases only slightly. Thus, households with higher income benefit more, as their share of income from skilled labor and capital is higher.
  - The factor price for land (which can be interpreted as the rental rate) declines by 20.8%. Thus, income of most rural household groups increases less than income of urban households, as rural households have a higher income share from land.

- The development of factor prices may seem counterintuitive at first sight. It follows, however, logically from the effect of the PNIASAN: Increasing agricultural productivity has the effect that the factors which are overproportionally employed in agriculture become relatively less scarce. These are unskilled labor and land. Furthermore, land is getting even less scarce, as agricultural area expands. Therefore, the production factors, which are employed less than proportionally in agriculture, capital and skilled labor, are getting relatively scarcer and thus more expensive.

- The combination of the pro-poor welfare effects resulting from lower food prices and the non-pro-poor welfare effects resulting from changes in factor income combine in a way that the resulting welfare effects are higher for rural households than for urban households (5.2% against 3.4%).

- All household groups experience substantial positive welfare effects, varying between 1.3% (lowest rural income quintile) and 6.1% (fourth rural income quintile) of the 2021 BAU income. Welfare effects in 2021 are non-pro-poor in rural area (driven by factor income) and pro-poor in urban areas (driven by food price effects and the funding of the PNIASAN through direct household taxes mainly paid by high income households).

6.4 On policy implications

- Increasing productivity in agriculture and enhancing land supply leads to lower agricultural and food prices. While this is desirable from a consumer perspective, it may be problematic for agricultural producers, especially if the negative price effects overcompensate the positive productivity effects. Such negative price effects would be buffered by increasing exports, which can be supported by investments in physical as well as informational infrastructure in order to enable agricultural supply from Benin to be processed as well as traded (market information systems, roads, reduced red tape). Especially the neighboring countries in West Africa could be targeted due to good accessibility, similar preferences and comparably low requirements in terms of standardization.

- The productivity and land targets implied by the PNIASAN make the economy of Benin better off. Their achievement, however, is not automatically pro-poor: with respect to income, richer households benefit more than poorer households and the poorest rural households even experience an income loss. Looking at total welfare, all households benefit, but in absolute terms, households with higher incomes benefit more.
- This implies the need for an implementation of the PNIASAN or any future plans such that they target the poor as well as for complementary policies, if the government of Benin intends this plan or future plans on agricultural development to be pro-poor.
- On targeting the funding of the PNIASAN or any future plans such as to be pro-poor:
  - The household groups with relatively high income benefit most from the PNIASAN in absolute terms. Therefore, it seems adequate to overproportionally involve them in funding the PNIASAN.
    - This is assumed in the PNIASAN scenario in this report, where the additional public expenditures for the PNIASAN are raised through income taxes, mainly paid by the three upper urban income quintiles.
    - But the income tax system in Benin is not yet well developed. Therefore:
      - In the long run, the income tax system should be developed such that all income source and not just wage income be taxed.
      - In the short run, other taxes which are mainly born by wealthy households such as real estate property taxes may instead/complementary be used.
- On targeting the measures of the PNIASAN and any future plans and complementary policies such as to be pro-poor:
  - The provision of public services should be explicitly targeted at agricultural smallholders:
    - Extension and training may especially be provided in regions and communities with a high share of smallholders and/or directly address smallholders.
    - Access to inputs (fertilizer, plant protection, machinery, animal feed) should be especially improved for agricultural smallholders.
    - Special programs may support smallholders through combined training on, and the provision of micro-finance and subsidies for simple technologies such as fuel saving ovens, water containers for irrigation, water harvesting technologies and simple processing technology such as fruit and vegetable dryers.
    - The development of public market information systems which are accessible by simple means such as mobile phones could empower smallholders in their negotiating position when selling their products.

        - Public road infrastructure in remote areas has a strong potential to link farmers to markets for selling their products as well as purchasing inputs. It also improves access to medical care and schools.
    - Incentives may be provided to urban households, which own an increasing share of agricultural land, to put their land to use and invest in agriculture and agricultural processing in a way that is labor intensive. This might provide employment opportunities for unskilled workers and hence reduce the negative income effects experienced by poor rural households, and it would stimulate the rural economy as a whole. Also, this would help to expand farmed area as foreseen in the PNIASAN without the need to exploit new land reserves.
        - This may be achieved for example through lower property taxes on agricultural land if put to use compared to unused land and other tax reliefs for stimulating investments in the rural economy.

- On the role of capacity building for the design of future development plans for agriculture.
    - The current plan has been developed without a quantified assessment of the potential economy-wide effects. For the future, we recommend that the Government of Benin develops in-country capacity to conduct such analyses. Such investment may involve:
        - A two-year capacity building program for the national statistical office and the statistical division of the ministry which should result in the development of a sound SAM, adequate to address the economy-wide implications of agricultural development in Benin.
        - A two-year training program for selected staff members of the ministry of agriculture and potentially other government institutions to conduct such analyses independently. Ideally, such a program would be set up in collaboration with Universities in Benin to develop the capacity of the next generation of policymakers and policy analysts.

- On the importance of reflecting upon the funding of agricultural development plans.
    - The PNIASAN has been silent on how the government would finance its part of the plan.
    - For future plans, the question of how to finance the additional expenditures should be addressed more explicitly, as this will have important implications for the economy-wide effects of the plan.
    - The ministry of agriculture should work together with the ministry of finance to identify feasible options. Such options may include the variation of existing tax rates (income taxes, sales taxes and taxes on trade) as well as the reduction of government expenses for other objectives. A modelling team resulting from the capacity building recommended above may support this process by providing analyses regarding the implications of the different options.

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