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# The (Arab) Agricultural Investment for Development Analyzer (AIDA)

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## An Innovative Tool for Evidence-based Planning

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## TABLE OF CONTENTS

Abstract.....	iii
1. Introduction .....	1
2. Contextualizing Agricultural Investment Plans.....	2
3. The Agricultural Investment for Development Analyzer .....	4
AIDA Investment and Policy Analysis .....	5
The AIDA Handshake .....	6
AIDA Economy-wide Model .....	7
4. Conclusion and way forward .....	12
References .....	13

## LIST OF FIGURES

Figure 2.1: Types of Policy Challenge.....	2
Figure 2.2: Sector-wide Perspective: Unpacking Agricultural Programs .....	3
Figure 2.3: Evaluating Investments and Policies.....	4
Figure 3.1: Components of the (Arab) Agricultural Investment for Development Analyzer (AIDA).....	4
Figure 3.2: Online Modeling Framework .....	11

## ABSTRACT

This paper describes an innovative agricultural and rural economic planning tool that will help governments and analysts in the design of agricultural investment plans: the (Arab) Agricultural Investment for Development Analyzer (AIDA). A policy challenge for all governments, including those in the Middle East and North Africa, is determining the appropriate allocation and quality of public spending to foster agricultural and rural economic growth, employment creation, and poverty reduction. The AIDA economic planning toolkit has been built using an economy-wide and minimalistic investment data approach to assist governments in meeting this planning challenge. Centered on the use of economy-wide Computable General Equilibrium (CGE) models, it allows for a comprehensive planning approach to ensure that the level and allocation of investment in the agriculture and rural sectors is sufficient for achieving desired targeted outcomes. It does this by linking agricultural and rural spending to economic growth, job creation, and household poverty, given resource and market constraints, as well as considering trade-offs and opportunity costs associated with different investment options. Such a holistic system approach enables the ranking of possible interventions and allocations of public funds amid possible changes in public policy to help in designing national agriculture plans and targets.

## 1. INTRODUCTION

Growth of the rural economy, including agriculture and related activities such as agro-processing and services, is particularly important in low and middle-income countries for achieving poverty reduction, food security, generating employment, and enhancing structural change towards higher value-added activities (World Bank 2007; Diao et al. 2007; IFAD 2016). The Middle East and North Africa region is no exception. Excluding high-income countries in the region, the agriculture sector in MENA contributes around 11 percent of GDP (Benfica et al. 2017; World Bank 2017; Nin-Pratt et al. 2018). The sector also provides jobs for 19 and 15 percent of workers in lower-middle and upper-middle income groups, respectively. Agro-processing makes a significant contribution to GDP in the region, providing 6.1 percent and 3.6 percent of GDP for Egypt and Tunisia, respectively. Likewise, the share of agro-processing in employment is 6.4 percent in Egypt and 3.2 percent in Tunisia. For poverty reduction, agricultural growth is still relevant in MENA, especially in low income countries, like Yemen, where the share of agriculture in employment is 44 percent and more than half of the population lives in rural areas. In Egypt 57 percent of the poor live in rural areas of Upper Egypt, while 20 percent of the poor live in rural lower Egypt. In Tunisia, more than half of the poor live in rural areas (World Bank 2017, Nin-Pratt et al. 2018; Goyal and Nash 2016).

Public agricultural investment and development projects can be key drivers of growth in the rural economy, while also improving food security, creating employment, and accelerating poverty reduction. Such investments affect welfare and economic productivity and growth in the long run (Glomm and Ravikumar 1997; Teruel and Kuroda 2005). The stability and predictability of such investments are important to encouraging private investment (Aschauer 1989). Appropriate public expenditures in agriculture and in rural areas more broadly are particularly crucial to the transformation of the sector across low and middle income countries. However, given limited public resources and the low levels of investment undertaken in many such countries, determining the appropriate allocation and quality of public spending remains a policy challenge for all governments (Bathla et al. 2017). Likewise, funds from international development partners are limited and compete for alternative uses among different countries, sectors, and within different sectors (Brzeska et al. 2012).

To help governments and their development partners design their agricultural investment plans and more effectively and efficiently allocate their resources, evaluations of development projects in agriculture and other rural sectors have increased in number and importance. However, such evaluations often only are focused on the direct impact of the project itself or use sector-specific statistical approaches to identify the best allocation of investment spending. However, especially in low and middle-income countries, in general, and in MENA countries, specifically, data are often not available or are inadequate to study the relationships between investments, growth, and social outcomes. In addition to data limitations, such traditional investment assessment and impact evaluation approaches do not comprehensively take economy-wide linkage effects into account. Finally, such approaches often fail to take into account the policy context and potential policy changes during the lifetime of an investment plan.

In this paper we present an innovative investment assessment and planning tool that uses an economy-wide and minimalistic investment data approach which incorporates aspects of the policy dimension for designing national agricultural investment plans in MENA and comparable

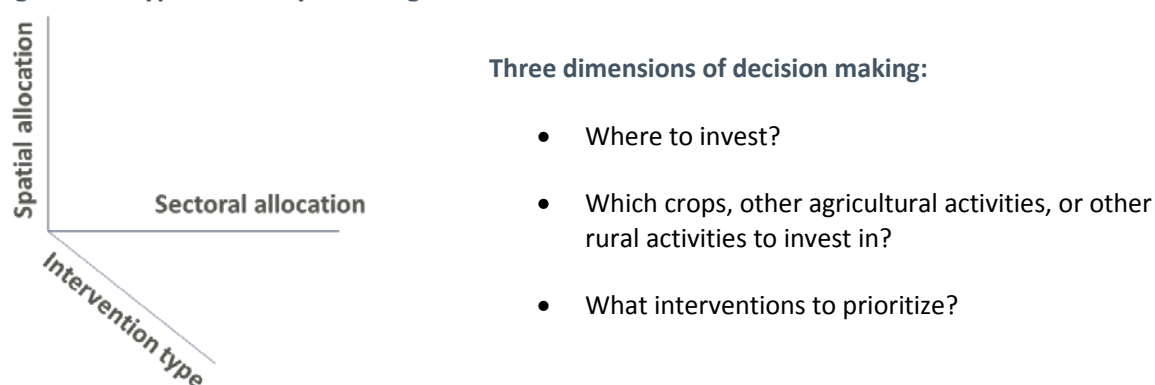
regions and countries: the (Arab) Agricultural Investment for Development Analyzer (AIDA).<sup>1</sup> AIDA allows for a comprehensive planning approach to ensure that the level and allocation of investment is sufficient for achieving the targeted outcomes. It does this by linking agricultural spending to economic growth, job creation, and household poverty, given resource and market constraints, as well as considering trade-offs and opportunity costs associated with different investment options. Such a holistic system approach enables the ranking of possible interventions and allocations of public funds amid possible changes in public policy to help in designing national agriculture plans and targets.

The paper is structured as follows. Section 2 provides an overview of the multiple dimensions that are relevant for designing an agricultural investment plan. Section 3 presents the various components and steps in building AIDA, including the investment/project analysis; the handshake that links the investment/project with the economy-wide analysis; and the offline and online simulation tools. Section 4 concludes by giving an outlook on forthcoming country applications of AIDA.

## 2. CONTEXTUALIZING AGRICULTURAL INVESTMENT PLANS

Designing investment plans is a challenging process, as the government has to allocate scarce resources while taking into consideration three dimensions of investment allocation: the spatial allocation, the sectoral allocation, and the possible policy changes that may occur (Figure 2.1).

**Figure 2.1: Types of Policy Challenge**



Source: Authors' representation

With regard to the spatial allocation, the government and its development partners need to consider the various trade-offs that will emerge when choosing between potential public investments or agriculture projects in different regions of a country or region. For example, often a key decision involves choosing to invest in high agricultural productivity areas versus low productivity areas.

With regards to decisions around the sectoral allocation of the investments, in the planning process, a program usually includes a collection of different packages of interventions. Each package incorporates change in public investment that require consideration of alternative investment interventions within the agricultural sector and how they should be prioritized.

<sup>1</sup> The (Arab) Agricultural Investment for Development Analyzer (AIDA) is a tool that is being developed as part of three-year project (2017-2020) with the same title funded by IFAD with co-financing from CGIAR-PIM and implemented by IFPRI and its partners with focus on Egypt, Jordan, Lebanon and Tunisia. AIDA builds on the previous IFAD-IFPRI-CGIAR PIM project "Decreasing Vulnerability to Conflict in Arab Countries through Rural Development".

The third dimension emphasizes the nature of the interventions (Figure 2.2). For instance, planners and investors can choose between investing in irrigation infrastructure, input subsidies, rural roads, and so on. In addition, implementing an investment portfolio is most likely to be accompanied with the introduction of other policy changes or reforms. Examples of these reforms include macro-economic policies, such as indirect tax rates, quantitative restrictions, or exchange rate adjustments; social insurance programs, such as cash transfers to households; and changes in regulations, such as setting quality standards or restricting land access.

**Figure 2.2: Sector-wide Perspective: Unpacking Agricultural Programs**



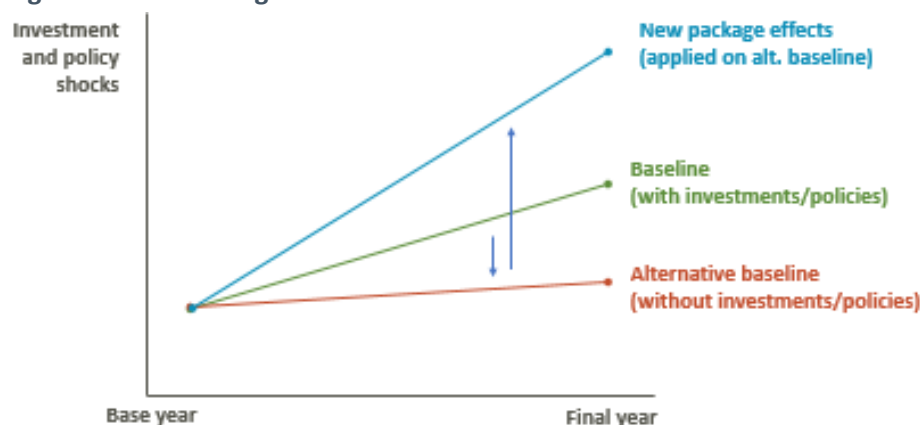
Source: Authors' representation

Hence, in the planning process, national agricultural planners should take into consideration all the above-mentioned dimensions. The selection among different investment alternatives should be implemented by tracking downstream spillovers and trade-offs. Moreover, evaluating investment options should be based on a system-wide approach in order to track both the forward and backward linkages of any particularly investment in the agriculture sector.

Ideally, agricultural investment plans should also take into consideration the economy-wide impact of different packages of investments and policies. This includes a close examination of the on-farm versus downstream value-added impacts of an investment or policy reform, as well as estimating the number of jobs created and how many people might be lifted out of poverty. Assessments should be made in the planning process of spatial trade-offs of different investment or policy packages, such as growth in high-return areas versus poverty reduction in lagging areas. Similarly, the temporal scale of any impacts should be considered. Evaluating the impact of short versus long run investment or policy packages, for example, fertilizer subsidies versus irrigation infrastructure, can greatly enhance the targeting of investments. Important information that is needed for agricultural investment planning is around the financing options for these interventions, whether through raising taxes, foreign borrowing, or reducing other types of spending, and what are the broader, economy-wide implications of these different financing options. In addition, it is important to evaluate the effect of policy changes on the outcomes of new investment package(s), the likely impacts of increasing investment expenditures, and possible ways for improving investment efficiency.

In order to comprehensively assess agricultural investment plans and answer the questions posed above, a tool is needed that compares investment packages against a scenario with investments and policies as usual and a scenario with no investments or policies at all – that is, with and without comparison (Figure 2.3). The next section presents such a tool – AIDA.

**Figure 2.3: Evaluating Investments and Policies**

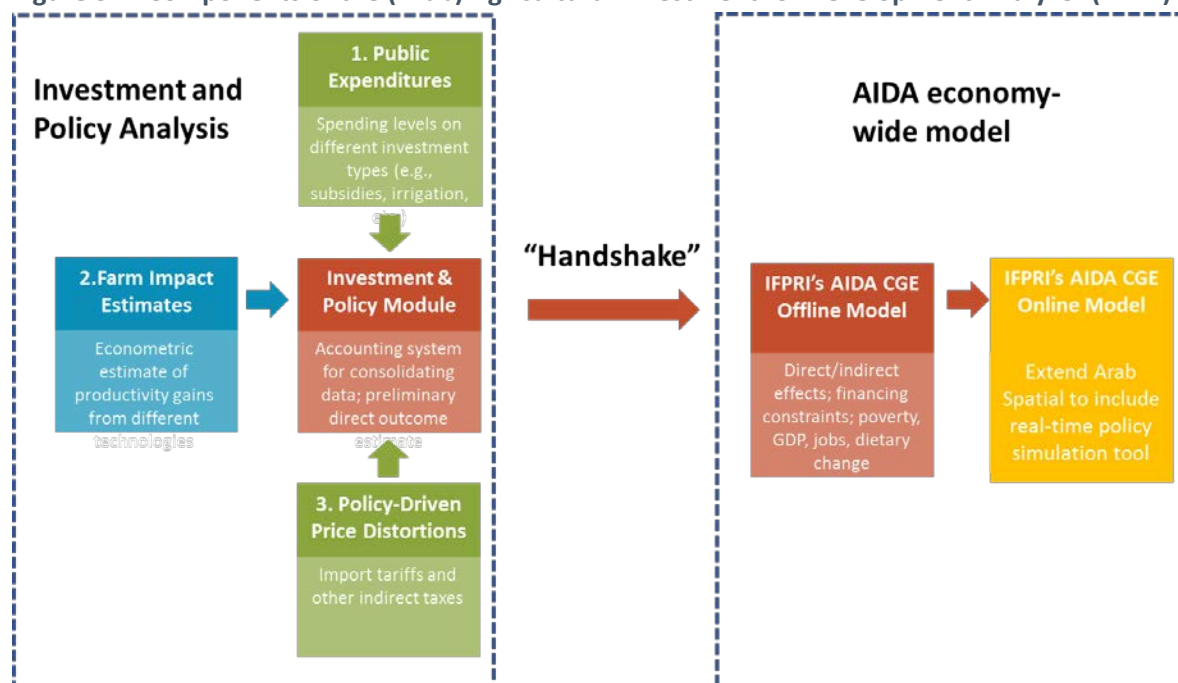


Source: Authors' representation

### 3. THE AGRICULTURAL INVESTMENT FOR DEVELOPMENT ANALYZER

The (Arab) Agricultural Investment for Development Analyzer (AIDA) is an economic development planning toolkit that consists of three main components: an investment and policy analysis module, the AIDA offline model, and the AIDA online model (Figure 3.1).

**Figure 3.1: Components of the (Arab) Agricultural Investment for Development Analyzer (AIDA)**



Source: Authors' representation

AIDA combines investment and economy-wide impact assessments, to investigate which interventions and policies should be prioritized over others among the agriculture sub-sectors. This holistic approach takes a national investment planning perspective by integrating both analysis of

agriculture investments and policies with ex-ante modeling of agriculture growth and poverty linkages, using economy-wide Computable General Equilibrium (CGE) modelling. This analytical tool can help in consolidating information on past investment and policy impacts to identify which combinations of rural investments are the most efficient for achieving different objectives. The following sub-sections explain in detail each AIDA element in Figure 3.1.

### **AIDA Investment and Policy Analysis**

The first component of the AIDA toolkit is the investment and policy module. The main objective of this component is to generate new knowledge about the impacts of projects and public investments on agricultural productivity. The module includes a desk review (item 1 in Figure 3.1) of public expenditure patterns, best practices and successful investments, tradeoffs between alternative investment projects and what the major impact channels are. Farm impact estimates (item 2) can be derived either from data-intensive econometric analysis or from the literature. Information on policies and price distortions (item 3) complete the module. These three elements of the investment and policy module together inform the choice of values for the CGE model parameters, which constitutes the “handshake” between the public investment analysis and the CGE model. We now discuss these model parameters in turn.

#### **(1) Public expenditures**

The first type of handshake variables/parameters are the outputs of the public expenditure analysis that are considered as intermediate inputs to the AIDA economy-wide model. These variables consist of the following, among others:

- Level of public expenditures per sector, e.g., on irrigation, extension, rural road construction, fertilizer, etc.;
- Amount of physical infrastructure, goods, and services that result from the public expenditures;
- Unit cost to the public sector in creating or acquiring these physical infrastructure, goods, and services; and
- Share of farmers that have access to each of these types of infrastructure, goods, and services.

#### **(2) Farm impact estimates**

Parameters for the potential impacts of investments and policies at farm-level can be obtained through different ways. The sort of parameters on the impact of specific investments that would be sought for use in the economy-wide CGE model might include, for example, the impact of constructing 10 km of rural road on reducing travel time to access key economic or social services or the impact of training extension workers on increasing the knowledge of farmers and subsequently increasing their crop yields.

Arranged in order of preference, the first method of estimation is through an econometric analysis of the impact of public expenditures on farm-level productivity for different sub-sectors within agriculture. Although this is the most preferred approach, it is also the most challenging one since it depends on data-intensive analysis. The viability of this econometric analysis highly depends on data availability at the household or sub-national level.

Several studies have implemented such farm household level analyses in different contexts. For instance, Mogues (2011) explored the impact of public expenditures on households’ rural income in Ethiopia using both sectoral- and household-level analyses. Another study by Benin et al. (2012) estimated the impact of agricultural public spending on agricultural productivity in Ghana



using an instrumental variable regression approach. In a similar vein, Dillon et al. (2011) employed an instrumental variable approach to estimate the impact of public investments on land values, household consumption and agricultural income in Nepal. A recent study by Guo et al. (2016) measured the effect of local public spending on in-county investment and consumption across 1,800 counties in China. Focusing on government subsidies and investments in the agriculture sector, Fan et al. (2008) assessed the impact of government spending on agricultural growth and poverty reduction in rural India. Similarly, several studies have implemented a simultaneous equations approach to estimate the impact of public expenditures on agricultural productivity and poverty (e.g., Fan et al. 2000a, 2000b, 2003, 2004; Fan and Zhang 2008).

The second alternative is a review of the peer-reviewed research literature of papers that analyze the impact of rural investments at national or sub-national level within the AIDA target countries or countries with similar economic contexts. A third option is to expand the literature review to examine the grey literature, i.e., unpublished reports, such as impact evaluations that have been done for individual donor-funded projects. A fourth approach is to base the model parameter values on theoretical impacts estimated using agronomic data. Finally, expert opinions on the potential impacts of different investments is an important complement to any quantitative analysis, especially in contexts where quantitative data are scarce or not directly accessible.

### (3) Policy-driven price distortions

To comprehensively assess agricultural investments, it is also important to consider variables associated with specific policy changes in government agricultural policies that can have a direct impact on investment plans. These are often country-specific and can include, for example:

- Provision and allocation of irrigation water to farmers within the Nile river basin;
- Prioritization of wheat cultivation as part of the national food security strategy;
- Reclamation of desert land through large-scale irrigation and construction projects;
- Expanded provision of agricultural extension services;
- Subsidization of fertilizer production;
- Subsidization of credit for farmers;
- Construction of rural infrastructure;
- Agricultural research and development;
- Agricultural commodity price support through guaranteed government purchasing; and
- Indirect impacts on demand for agricultural commodities through food subsidies.

Once these three sets of parameters for the CGE model have been compiled, they are fed into the economy-wide model through the AIDA "handshake" mechanism.

### **The AIDA Handshake**

When considering how best to plan sector-specific investments for generating net positive economy-wide development outcomes, the existing research literature is both limited and somewhat inconsistent. In Uganda, for example, it was found that directing investments towards agricultural research and extension services was more effective in stimulating economic growth and reducing poverty compared to investments in both irrigation and rural roads (Pauw and Thurlow 2015). In Mozambique, investments in extension services were more effective in reducing rural poverty than were irrigation and fertilizer subsidies (Benfica et al. 2017). AIDA follows the approach proposed by Pauw and Thurlow (2015) and Benfica et al. (2017) where a consistent economy-wide model is applied, combining ex-post household econometric analysis of agricultural investment impacts with ex-ante modeling of agriculture's growth and poverty linkages.

Building on these examples, the AIDA handshake process uses information from the AIDA Investment and Policy Analysis and integrates it into a dynamic computable general equilibrium (CGE) model that constitutes the second part of AIDA (following section). There are three types of handshake parameters/variables.

- Handshake 1 include the impact parameters that are estimated as a result of performing the econometric analysis of the impact of different kinds of investments in the agriculture sub-sectors on agricultural productivity, at the household or governorate level, depending on data availability. These impact estimates and unit costs of investments, are needed to parametrize the investment equations in the CGE model.
- Handshake 2 parameters draw on project data, to extract the impact parameters, elasticities, and unit costs of investments at the project level.
- The third type of handshake parameters focuses on possible policy changes in the AIDA country in which the planning toolkit is being applied.

### AIDA Economy-wide Model

Here we describe two new and innovative versions of the CGE model, the AIDA offline and the AIDA online versions.

#### Offline AIDA

Offline AIDA builds on a desktop version of the CGE model, as described in Diao and Thurlow (2012). The offline AIDA uses an Excel-based interface, in which the different scenarios are designed and the results are viewed in the MS Excel spreadsheet program. This makes modeling easier to do, keeping the user focused on investment choices, rather than complex modeling, and reducing the cost of modeling analysis. This simple interface provides a beneficial opportunity to ministries and other decision-making agencies, encouraging them to use CGE modelling as part of the toolkit their planners use, without having to establish expensive dedicated modeling units.

#### *The generic structure of the Computable General Equilibrium models used in AIDA*

CGE models provide a comprehensive and consistent approach for measuring the ex-ante economy wide effects of rural policies and investments. Such models capture rural and urban linkages and can measure the impact of alternative investment policies on macroeconomic outcomes, labor markets, and household welfare. Also, CGE modelling can simultaneously evaluate the impacts of many investment scenarios and examine a set of alternative assumptions, providing opportunities for open national debate on various rural investment priorities. There is a growing reliance on CGE modelling among many government ministries in the MENA countries and elsewhere as a powerful analytical tool for decision-making, including in evaluating agricultural investment policies.<sup>2</sup>

CGE models solve for the equilibrium between demand and supply of factors and products. The model captures both production and consumption linkages. Production linkages are composed of backward (demand on intermediate inputs) and forward (supply of inputs) linkages. Production expansion affects factor income, that is used for consuming goods and services. Many country-specific CGE models, including those for AIDA, contains production functions by sub-national region in order to capture the specific socio-economic features of each main part of a country.

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<sup>2</sup> Many factors have contributed to this, including the standardization of such models, improvements in data availability, sensitivity analyses that lead to more robust results, as well as the advancement in ex-post micro impact evaluation techniques.

Producers in each sector or region combine factors of production (land, capital and land) using a constant elasticity of substitution function under constant returns to scale, generating factor income. Labor is divided into four categories – uneducated, primary, secondary, and tertiary educated workers – within rural farm, rural non-farm, and urban areas. Aggregate factor value-added is combined with total intermediate inputs in fixed proportions. Land and labor in the models are mobile across sectors, but not across regions, and their total supply grows following historical trends. Past investment determines new capital stocks, which are allocated according to sectors' relative profitability. Once invested, however, capital becomes immobile and earns sector-specific returns (Pauw and Thurlow 2015).

In the model, domestic and foreign goods are imperfect substitutes, with producers' decision to supply export markets and consumers' decision to buy imported goods based on changes in relative prices. All domestic, import and export prices include relevant indirect taxes, and the current account balance is maintained through changes in the real exchange rate (Benfica et al. 2017).

In use, the time horizon of the AIDA CGE models is country-specific and is likely to follow the time horizon of countries' national development strategies. For example, in the case of Egypt the time horizon may be until 2030, following the Egypt 2030: Sustainable development strategy (SDS); while in the case of Jordan, possibly 2025, in alignment with the *Jordan 2025: A national vision and strategy* master development plan. The exact time horizon should be discussed and decided upon by consulting relevant partner institutions.

Public investments modelled in AIDA, for example, on irrigation, extension services, and rural roads, are not determined endogenously in the model, because we assume that they have direct impacts on changes in total factor productivity of the relevant sub sectors. Productivity rates of these sub sectors are determined endogenously, whereas the productivity rates of all the other sectors are exogenously determined.

Within AIDA, investment equations measure the impact of public spending on agricultural productivity. Impacts on agricultural productivity are then modeled using nested equations. The economy-wide model contains production functions for each sector in each subnational region. Equation (1) is a production function in which producers combine labor  $L$ , land  $N$ , and capital  $K$  to produce total output  $Q$  in time  $t$ .

$$Q_t = \alpha_t F(L_t, N_t, K_t) \quad (1)$$

We assume that public investment spending in the agriculture subsectors could affect the value of the shift parameter  $\alpha$ , which is a measure of total factor productivity (TFP).

In order to investigate how best to allocate public expenditure within the agricultural subsectors, we discuss three examples here:

- Irrigation, which could be treated as an asset investment that depreciates over a long time period and requires maintenance costs;
- Rural roads, which contribute to facilitating the transportation of agricultural inputs and final products as well as easing market access; and
- Extension services, which provide farmers with knowledge and awareness.

The investment equation is determined by the outcomes of public investment spending on irrigation, extension activities, and rural roads. Consequently, the change in investment will determine productivity growth, as follows:

$$\frac{\dot{\alpha}_t}{\alpha_{t-1}} = \beta_0 + \beta_1 \frac{\dot{R}_t}{R_{t-1}} + \beta_2 \frac{\dot{I}_t}{I_{t-1}} + \beta_3 \frac{\dot{E}_t}{E_{t-1}} \quad (2)$$

Where  $R$  is density of feeder roads measured in kilometers;  $I$  is the share of farm land under irrigation;  $E$  is the share of rural farmers receiving extension services; and  $\beta_1$ ,  $\beta_2$ , and  $\beta_3$  are the percentage change in TFP resulting from one percentage change in the investment outcome, i.e., irrigation, rural road, and extension services, respectively.

The right-hand side of the equation refers to the impact of changes in the investment outcome (roads, irrigation, and extension services), that are derived from public investment expenditures and estimated unit costs. For this we estimate three equations to estimate the investment outcomes, as follows:

Both roads and irrigation are assumed to be a capital stock, so that part of the investment spending is devoted to maintenance activities. In contrast, extension services are considered as recurrent expenditure.

The outcomes of investments in roads and irrigation stock are determined by the following equations:

$$R_t = \frac{(1 - m^r)R_t^e}{r \cdot A} \quad (3)$$

$$I_t = \frac{(1 - m^i)I_t^e}{i \cdot C_t} \quad (4)$$

The outcomes of investments in agricultural extension services is as follows:

$$E_t = \frac{E_t^e}{e \cdot H_t} \quad (5)$$

In these equations,  $R_t^e$  is government spending on feeder roads;  $m^r$  is the share of spending on road for maintenance;  $r$  is the unit cost of building one kilometer of new road;  $A$  is total regional land area;  $I_t^e$  is spending on irrigation;  $E_t^e$  is spending on extension;  $I$  is irrigation cost per hectare;  $m^i$  is the share of spending for maintaining the irrigation infrastructure;  $e$  is the cost of providing agricultural extension services per rural farm household;  $C_t$  is total cropland area; and  $H$  is the number of rural farm households

As an advantage of this hybrid approach, these equations can be estimated using the elasticities ( $\beta_1, \beta_2, \beta_3$ ) and the unit costs ( $r, i, e$ ) that are provided out of the econometric work in the AIDA investment and policy module. Based on data availability, we may also derive region or governorate-specific coefficients.

The model differentiates among households using five expenditure quintiles within each sub-national level region, plus by rural farm, rural non-farm, and urban. For example, in the case of the application of the model in Egypt, 105 household groups were identified by separating Egyptian households into the seven sub-national regions, with the five household quintiles disaggregated by urban/rural farm/rural nonfarm for the seven regions. In the case of other countries where AIDA will be applied, we aim to follow the same structure, depending on data availability.

Each of these representative households receives incomes according to their factor endowments, pays taxes, saves, and consumes goods and services. Consumption demand of

households is determined by a linear expenditure system (LES) of demand, that can distinguish between necessity goods (elasticity less than one) and luxury goods (elasticity greater than one). Thus, changes in income induce different responses among the various types of households, depending on their income elasticities (Diao and Thurlow 2012). Income elasticities can be estimated using data from available household surveys in the four AIDA's focus countries. Alternatively, if such data is not available, the elasticities can be developed from previous estimates in the empirical econometric literature.

The government receives direct and indirect taxes and foreign aid, and uses these revenues to pay for recurrent spending and investment. Private, public, and foreign savings, i.e., net capital inflows, are pooled and used to finance domestic investment. We initially assume that public spending tracks recent trends and that the fiscal deficit adjusts to equate revenues and expenditures. Households' savings rates are fixed and investment adjusts to equal savings in equilibrium.

Depending on the accessibility of household survey data, a micro-simulation module to measure changes in poverty can be included, where each household group in the model is linked to its corresponding survey households. Changes in real consumption spending are passed down from the CGE model to the survey, where poverty measures and changes in poverty are calculated (Pauw and Thurlow 2015).

### *Policy and investment scenarios that can be run using AIDA*

**Model Calibration and the Baseline Scenario.** In using the CGE model in AIDA, first we calibrate the model, which involves assigning values to model parameters and variables. This is done by depending on the most recent Social Accounting Matrix (SAM) for the country in question. The SAM represents the fundamental database for CGE modeling.

After calibrating the model to the SAM, a baseline scenario is established, which is a business-as-usual economic growth path that assumes that future growth rates for factor supply will follow recent historical trends. The baseline scenario assumes no policy changes and serves as counterfactual for the investment simulations.

**Alternative Investment Scenarios.** In the investment scenarios, public investments increase in specified agricultural sub-sectors, such as irrigation, extension services, and rural roads. Related productivity changes in these sectors will be determined by the investment outcomes equations. The number and scope of the scenarios modeled will depend on the country context.

As an illustrative example, we might simulate four investment scenarios as follows. First, we might increase rural investments based on the planned public investment allocations into the agricultural sub-sectors, as proposed in the individual country investment plans (Scenario 1). In the other three scenarios, we might scale up public expenditures allocated to the agriculture sector by 10 percent.<sup>3</sup> We then distribute half of this amount according to the baseline allocations, with the rest devoted either to irrigation (Scenario 2), to extension services (Scenario 3), or to rural roads (Scenario 4).

Other possible model simulations can entail changing public expenditures in fertilizer input subsidies; animal medicine and veterinary services; land expansion investments to increase land

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<sup>3</sup> East and South Asian countries devoted around 10 percent of their total public spending to agriculture during their periods of high agricultural growth (Goyal and Nash 2016).

supply, e.g., terracing or land reclamation; or price-based investments, such as import tariff changes or consumer fuel or food subsidies.

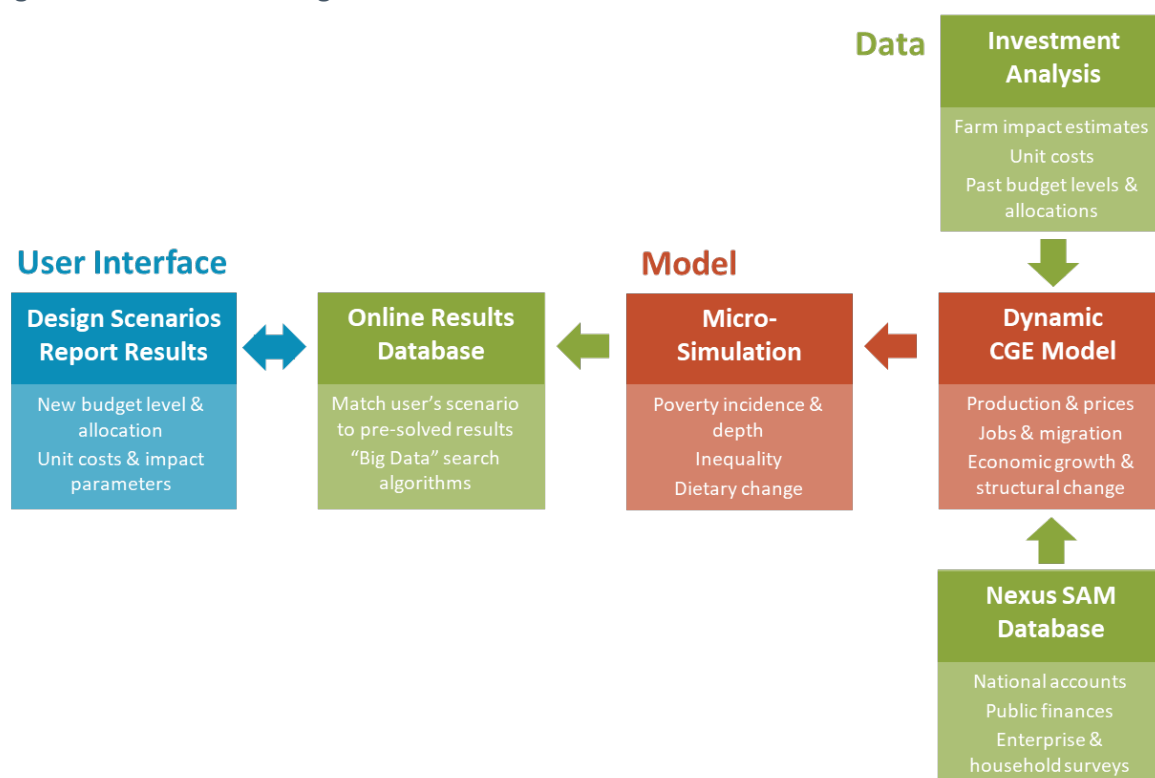
As a sensitivity check on the results obtained under each scenario, we can examine the modelled changes in investment efficiency by increasing or lowering unit costs or by simulating different combinations of unit costs and elasticities in the scenarios.

### Online AIDA

Online AIDA will be built as an accessible online toolkit that would allow international partners, governments, and analysts to evaluate country and project-specific planning questions in a dynamic and customized way in real-time. To create the online AIDA, the offline AIDA model will be pre-run thousands of times to capture a broad range of possible policy scenarios.. These many simulations will basically be used to generate a modeling results database. Users will be able to allocate resources to different investment opportunities and locations, and submit this selection to an online platform containing the results database. The database then matches the user-selected portfolio to a set of anticipated investment outcomes that exist in the results database. Users can then adjust their allocations or assumption about investment costs and implementation efficiency in order to see how outcomes may be improved. Users can then download the dataset containing the results from their selected investment portfolios. Online AIDA will include a detailed user guide and online training materials (Figure 6).

Through this innovative online tool, users will be searching a database, a procedure which is much quicker than running a model. In addition, solutions to the modeling scenarios requested by the user are guaranteed, since the simulations are pre-solved and no modelling software knowledge or licenses required. The Online AIDA provides a great opportunity for more policy analysts to access this frontier planning tool.

**Figure 3.2: Online Modeling Framework**



Source: Authors' illustration

The typical development outcome indicators that can be generated by the online AIDA model for each investment and policy scenario examined are the following:

- National and agriculture-food system aggregates – GDP, employment;
- Macro distribution – investment versus consumption, private versus public demand;
- Sectoral distribution – agriculture versus non-agriculture, tradeables versus non-tradeables;
- Spatial distribution – different regional areas in the AIDA countries;
- Functional distribution – labor income versus capital income, skilled versus non-skilled labor income, etc.;
- Household distribution – rural versus urban, poverty headcounts and gaps, dietary change, among others.

#### 4. CONCLUSION AND WAY FORWARD

In this paper we have presented an innovative tool that will help governments and analysts in the design of agricultural investment plans: the (Arab) Agricultural Investment for Development Analyzer (AIDA). AIDA will make several contributions:

First, the investment module, based on comprehensive literature survey and econometric work, identifies key rural investment areas as well as provides the investment costs and impact parameters for different investments at the sub-national level.

Second, the offline AIDA, which is an economy-wide CGE model, will be applied with a special focus on agricultural and rural investments. It will help in the assessment of different investment portfolios and, hence, (re)prioritize investment alternatives according to their relative efficiency in achieving improved macroeconomic outcomes. The offline AIDA is targeted at users within the AIDA-focus countries who are familiar with CGE models and who require greater flexibility in adapting the model's parameters and specifications. The offline version of AIDA will include its own documentation and will be made available for downloading online and via IFPRI's partner networks. IFPRI's experience suggests that demand for the offline AIDA will primarily come from academic researchers, international organizations, and policy planning units within governments.

Third, the methods that will be applied using the innovative CGE modeling approach of the offline AIDA will result in the creation of an online modeling results database and toolset that will assist policy makers in the analysis, design, and reform of new agricultural and rural policies. Through the online AIDA, users will be able to design investment packages and view modeling results via a web-based interface by submitting proposed investment and policy packages to the online database. Users on online AIDA can also adjust allocations or assumptions about investment costs and implementation efficiencies to see how specific development outcomes are affected. The online AIDA targets users who need quick answers or a less-technical approach. Both the offline and online AIDA will be developed for each focus country to meet the needs of different users.

To ensure broad take up of AIDA in the partnering countries, local partners and policy analysts will be trained on the use of AIDA to systematically perform online assessments of the impacts of proposed policies and rural investment portfolios in order to prioritize them. Ultimately, it is expected that AIDA will support government and decision makers in designing policies and investment plans in a way that accelerates agricultural growth, creates rural jobs, reduces poverty, and improves food and nutrition security outcomes.



## REFERENCES

- Aschauer, D. 1989. "Is Public Expenditure Productive." *Journal of Monetary Economics* 23: 177–200.
- Bathla, S., S. Thorat, P K Joshi and B. Yu. 2017. "Where to Invest to Accelerate Agricultural Growth and Poverty Reduction." *Economic & Political Weekly*, vol. LII no 39.
- Benfica, R., B. Cunguara and J. Thurlow. 2017. *Linking Agricultural Investments to Growth and Poverty: An Economy-wide Approach Applied to Mozambique*, Forthcoming.
- Benin, S., Mogues, T., Cudjoe, G. and Randriamamonjy, J. 2012. "Public expenditures and agricultural productivity growth in Ghana." In *Public Expenditures for Agricultural and Rural Development in Africa.*, edited by T. Mogues and S. Benin. London and New York: Routledge, Taylor and Francis Group.
- Brzeska J., X. Diao, S. Fan and J. Thurlow. 2012. "African Agriculture and Development." In *Strategies and Priorities for African Agriculture: Economy-wide Perspectives from Country Studies*, edited by Diao X, J Thurlow, S Benin and S Fan. Washington DC: International Food Policy Research Institute.
- Diao, X. and J. Thurlow. 2012. "A Recursive Dynamic Computable General Equilibrium Model." In *Strategies and Priorities for African Agriculture: Economy-wide Perspectives from Country Studies*, edited by Diao X, J Thurlow, S Benin and S Fan. Washington DC: International Food Policy Research Institute.
- Diao, X., P. Hazell, D. Resnick, J. Thurlow. 2007. *The Role of Agriculture in Development: Implications for Sub-Saharan Africa*. Washington DC: International Food Policy Research Institute.
- Dillon, A., M. Sharma, and X. Zhang. 2011. "Estimating the Impact of Rural Investments in Nepal." *Food Policy* 36 (2): 250–258.
- Fan, S. 2000. "Research Investment and the Economic Returns to Chinese Agricultural Research". *Journal of Productivity Analysis* 14(92): 163-180
- Fan, S., C. Fang, and X. Zhang. 2003. "Agricultural research and urban poverty: The case of China." *World Development* 31 (4): 733-741.
- Fan, S., Gulati, A., Thorat, S.K. 2008. "Investment, subsidies and pro-poor growth in rural India." *Agricultural Economics*. 39: 163-170.
- Fan, S., P. Hazell and T. Haque. 2000. "Targeting public investments by agro-ecological zone to achieve growth and poverty alleviation goals in rural India." *Food Policy* 25: 411-428.
- Fan, S., P. Hazell, and S. Thorat. 2000. "Government spending, growth and poverty in rural India." *American Journal of Agricultural Economics* 82 (4): 1038-51.
- Fan, S. and Zhang, X. 2008. "Public expenditure, growth and poverty reduction in rural Uganda." *African Development Review* 20(3): 466–496.
- Fan, S., L. Zhang, and X. Zhang. 2004. Reforms, investment and poverty in rural China. *Economic Development and Cultural Change* 52 (2): 395-122.
- Glomm, G., and B. Ravikumar. 1997. "Productive Government Expenditures and Long-Run Growth." *Journal of Economic Dynamics and Control* 21 (1997): 183–204.
- Goyal, A. and John Nash. 2016. *Reaping Richer Returns, Public Spending Priorities for African Agriculture Productivity Growth*. Africa Development Forum, World Bank Group.
- Guo, Q., C. Liu, and G. Ma. 2016. "How Large Is the Local Fiscal Multiplier? Evidence from Chinese Counties." *Journal of Comparative Economics* 44 (2): 343–352.
- IFAD (International Fund for Agricultural Development). 2016. *Rural Development Report 2016: fostering inclusive rural transformation*. Rome.
- Mogues, T. 2011. "The bang for the birr: Public expenditures and rural welfare in Ethiopia." *Journal of Development Studies* 47(5): 735–752.
- Nin-Pratt, A., H. El-Enbaby, J.L. Figueroa, H. ElDidi, and C. Breisinger. 2018. *Agriculture and economic transformation in the Middle East and North Africa, A review of the past with lessons for the future*. Second Re-Submission as IFPRI Food Policy Report. Cairo and Washington D.C.
- Pauw, K. and J. Thurlow. 2015. "Prioritizing Rural Investments in Africa: A Hybrid Evaluation Approach Applied to Uganda." *European Journal of Development Research* 27 (3): 407–424.
- Teruel, R., and Y. Kuroda. 2005. "Public Infrastructure and Productivity Growth in Philippine Agriculture, 1974–2000." *Journal of Asian Economics* 16 (3): 555–576.



World Bank. 2017. World Development Indicators. Accessed January 29. <http://wdi.org>.

World Bank. 2007. *World Development Report 2008: Agriculture for Development*. Washington, DC.

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