EVOLUTION OF COUNTRY-SPECIFIC INVESTMENT REQUIREMENTS
OF AGRICULTURAL AND RURAL EXTENSION AND ADVISORY SERVICES

OCCASIONAL PAPERS ON **INNOVATION IN FAMILY FARMING**

EVOLUTION OF COUNTRY-SPECIFIC INVESTMENT REQUIREMENTS OF AGRICULTURAL AND RURAL EXTENSION AND ADVISORY SERVICES

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ABBREVIATIONS

ACCVI   Agricultural Climate Change Vulnerability Index

AgGDP   Agricultural Gross Domestic Product

CGIAR   Consultative Group for International Agricultural Research

EAS   Extension and Advisory Services

EDI   Extension and advisory services Demand Indicator

EVI   Environmental Vulnerability Index

FAO   Food and Agriculture Organization of the United Nations

GDP   Gross Domestic Product

GNI   Gross National Income

GNP   Gross National Product

ICT   Information and Communication Technology

IFAD   International Fund for Agricultural Development

LAC   Latin America and the Caribbean

MDG   Millennium Development Goal

NENA   Near East and North Africa

NGO   Non-governmental organization

PO   Producer Organization

PPP   purchasing power parity

SDG   Sustainable Development Goal

SEA   South East Asia

SSA   Sub-Saharan Africa

USD   US Dollar

SUMMARY

The FAO Research and Extension Unit undertook a study in 2009 to identify county-specific investment targets for agricultural and rural extension and advisory services (EAS) carried out by government agencies, civil society and private enterprises. It was a strategic decision to update the results in 2015 in order to provide feedback on the impacts that have occurred due to changes over time in the socio-economic parameters of the countries.

Dynamic investment scenarios compare socio-economic data with a 4-year lag in order to highlight the impacts of investment, specifically to (a) assess the evolution of countries between 2009 and 2013, and to (b) identify country-specific opportunities for potential saving and improvement through country studies. Scenarios specifically link achievements towards the MDGs and SDGs, improved food security and eradicating extreme poverty and hunger and investment in Information and Communication Technologies (ICTs) to EAS requirement.

The study builds on previous World Bank and FAO reports that made the general recommendation to set both research and extension investment targets in developing countries at 1 percent of agricultural gross domestic product (AgGDP). In order to define proxies for country-specific EAS investment targets, the authors developed an EAS investment model based on socio-economic macro-indicators (poverty, undernourishment, access to information and population density) and a method to define estimates for cost increases related to climate change. These parameters provided an estimated demand for EAS and EAS investments required to combat sustainable development challenges that agriculture faces in the early 21st century. Earlier results (2009 data) showed that about half of the 94 developing low and middle income countries should spend more than 1 percent of their respective share of GDP derived from agriculture and about a quarter of the countries, mostly in Africa and South East Asia, need to spend more than 2 percent of their AgGDP.

The paper reveals significant differences in average investment requirements in different regions and shows the additional EAS costs related to climate change and other areas that currently lack investment. The EAS model was updated with 2013 data and then compared with 2009 data in order to provide case studies or 'success stories' for development. 18 out of 80 countries, that took part in both studies, realized reduced annual investment requirement for EAS as a result of improvement in internet access, mobile subscription and/or achievements in food security and poverty reduction.

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CHAPTER 1
INTRODUCTION

The developing world witnessed an extraordinary period of food crop productivity growth over the past 50 years, despite increasing land scarcity and rising land values. Although populations had more than doubled, the production of cereal crops tripled during this period, with only a 30 percent increase in land area cultivated. The Green Revolution brought high-yielding varieties of cereal grains, expansions of irrigation infrastructure, modernization of management techniques, distribution of improved seeds, synthetic fertilizers and pesticides, yet was characterized by regional differences in performance (Wik, Pingali and Brocai, 2008).

Within this context two important externalities emerged: the environmental and the socio-economic impacts of the change. The slowdown in yield growth that has been observed since the mid-1980s can partially be attributed to degradation of agricultural resources. At the same time, transition from traditional agriculture, just like the industrial revolution in the 19th century and the informatics revolution in the turn of the 21st century, also increased economic disparities, with a widening gap between rich and poor. The poorest producers are the most vulnerable to losing their farmland due to debt, while the increased level of mechanization removed a large source of employment from the rural economy (Oasa, 1987). Faced by these risks, farmers are often returning to subsistence cultivation, rendering them more vulnerable to weather variability due to climate change. Some regions were able to adopt Green Revolution technologies faster than others for political and geographical reason, so inter-regional economic disparities also increased.

For many of the currently more than 1.1 billion people that are living in poverty, economic growth based primarily on agriculture and on non-farm rural activities, is essential to improve their livelihoods. The majority of the poor (over 70 percent live in rural areas), includes subsistence farmers, herders, fishers, migrant workers, artisans and indigenous people (IFAD, 2011). Promoting agricultural growth in rural areas and giving rural people better access to land, water, credit, health and education, is essential to alleviate poverty and hunger, to feed the growing population and address its changing consumption patterns. (FAO, 2009). Yet, agricultural growth will depend in the future less on input and land increase, but increasingly on total factor productivity, i.e. the performance of institutions, including research, extension and advisory services, and infrastructure (roads, ICTs, etc.) (Fuglie, 2012).

Despite successes in some areas in attaining the first Millennium Development Goal - cutting extreme poverty rate by half from its 1990 level - poverty still presents a great challenge. A second poverty line defined at USD 2/day shows only a slight decline since 1981, from 2.6 billion to 2.2 billion (in 2011) (World Bank data base). Hence, the Sustainable Development Goals (SDGs) strongly pursue poverty and food security goals, specifically in SDG Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture (UN SDKP, 2015). One of its indicators calls therefore for increased investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks in order to enhance agricultural productive capacity in developing countries, in particular in least developed countries (UNSTATS, 2017). The model we developed is quantifying these investment requirements of extension and advisory services (EAS)[1] based on country specific socio-economic indicators.

International organizations - FAO, IFAD, World Bank and the CGIAR group, amongst many others - have long history of research into supporting agricultural extension agencies and governments in developing countries to promote growth, in order to improve farmer's livelihood (IFAD, 2011; FAO, 2009; Swanson and Rajalahti, 2010). Agricultural and rural extension and advisory services (EAS) are amongst the most important factors to promote development by providing people with knowledge, education, new technologies, market access, and community empowerment.

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[1]   The authors changed the terminology from extension to 'extension and advisory services' (EAS) to emphasize the country approach of the investment model which includes all diverse advisory services of the different EAS stakeholders (public and private) in a country.

The FAO Research and Extension Unit that commissioned the current report, takes leadership in fostering innovation and learning in research and EAS in response to the knowledge, information, technology and capacity development needs of member countries. The Research and Extension Unit supports development by enhancing national agricultural innovation systems, particularly agriculture research institutions, and pluralistic, demand-led and market-oriented EAS through policy advice, technical support, projects, programmes, and research.

In line with the objective of the study we provide an update of a socio-economic database of a global EAS investment model developed by the same authors (Blum and Szonyi, 2014), and introduce dynamic impact scenarios linked to EAS investment requirements to (a) assess the evolution countries have been going through between 2009 and 2013 and (b) identify country-specific opportunities for potential saving and improvement through country studies. The global EAS model was prepared with the purpose of providing national investment targets for agricultural and rural EAS carried out by government agencies, civil society and private enterprises. It was a strategic decision to update the results in a study carried out in 2015 in order to provide feedback on the impacts that have occurred due to changes in the socio-economic parameters of the countries

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CHAPTER 2
MATERIALS AND METHODS

Earlier studies defined investment targets as a fixed 1 percent of AgGDP (Roseboom, 2004) or 2 percent of AgGDP (World Bank, 1981), based on the agricultural production level of developed countries. Our research argues that the 1 percent investment target would lead to underinvestment in more than 50 low-income countries and the 2 percent investment target falls short in at least 25 of 94 countries that participated in the first study in 2009. Low-income developing countries need to invest a greater percentage of their respective agricultural output into EAS, due to poverty and the lack of information technology infrastructure and other capacities. The socio-economic database was updated and extended to 130 countries in 2015, which provided an opportunity to highlight the dynamics of the system, and analyse the impacts of information technology, infrastructural and socio-economic improvements on the expenditure required for financing agricultural and rural EAS.

Our study uses an index-based approach. The idea of the index-based approach derives from the 'Capability Approach' economic theory developed by Sen (1985). It was strongly influenced by welfare economics, and despite debate about a core set of capabilities, efforts has moved towards developing improved indicators of development, well-being and quality of life, compared with output based measures, such as GDP. This led to the development of the UNDP Human Development Index (UNDP, 2015) and the Multidimensional Poverty Index (UNDP, 2016). Improvements in technology gave rise to geo-referenced approaches (Szonyi *et al*., 2010) linking poverty to natural resources endowment and climate change impacts. This present study uses a similar index-based approach to assess the agricultural and rural EAS investment and services requirement, but raises it to a further level. Indices are not only ranked, compared and averaged, but they are built into a linear algebraic function to link into other variables, like EAS investment requirement.

EAS investment requirement is strongly correlated with the number of people to be reached with advisory services, and depends on population density, available information technology, level of poverty and prevalence of under-nutrition. The selected list of parameters (Blum and Szonyi, 2014) are:

> (1) **poverty** using GNP per capita (measured in current international USD), rural poverty headcount ratio at USD 2 a day (as a percentage of population), and prevalence of under-nourishment (as percent of population);

> (2) **information access**: mobile cellular subscriptions (per 100 people) and internet users (per 100 people) and

> (3) **population density**.

We rank the countries according to each of these parameters, and translate the results to a 0 to 100 scale [Eq.1], where $B_{min}=1$ and $B_{max}=100$ (regardless of the number of countries in the sample) and A_{min} and A_{max} are the minimum and maximum values of the dataset.

$$B_x = B_{min} + (A_x\text{-}A_{min}) \times (B_{max}\text{ -}B_{min}) / (A_{max}\text{ -}A_{min}) \qquad \text{[Eq.1]}$$

Once ranking is established for each parameter (inverse ranking for rural poverty headcount ratio and prevalence of under-nourishment) a weighted average of all indicators is calculated from the average re-scaled rank values for **poverty** (3× weight); **information access** (2× weight); and **population density** (1× weight). The resulting **EAS Demand Indicator** (EDI$_x$), an estimate of the demand for EAS, has a value that defines need for EAS on a scale from 1 to 100. The EDI indicator shows the EAS investment requirement in an inter-country comparison, and provides a regional and country comparison of the investment needs for agricultural and rural EAS.

Roseboom (2004) suggested a potential average investment target of 1 extension advisor per 1,000 agricultural labourers, an approach that was further developed in this study. Countries with lower per capita income, higher incidence of poverty and under-nourishment, a lower level of information access and lower population density need greater investments to meet the EAS demands, with more extension advisors relative to the population. Therefore we set an interval for the extension advisor ratio from 500 to 2 000 active rural populations in the baseline scenario, and 500 to 1 500 for active rural populations in the climate change scenario covered by one extension advisor.

The weighted average **EAS Demand Indicator** (EDI$_x$) is re-scaled [Eq.2] in the interval [Θmin=500, Θmax=2 000] for the baseline and [Θmin=500, Θmax=1 500] for the climate change scenario in order to derive (Θ_x), '**one extension advisor per number of active rural population**' ratio.

$$\Theta(x) = \Theta(\min) + \frac{(EDI(x)-EDI(\min)) \times (\Theta(\max)-\Theta(\min))}{(EDI(\max)-EDI(\min))} \qquad \text{[Eq.2]}$$

This leads us to the 'Number of required extension advisors' (Ψx), where Ωx is the 'Number of Active Rural Population (aged 15 to 65)' in each country.

$$(\Psi x) = \Theta(x) \, / \, \Omega(x) \qquad\qquad \text{[Eq.3]}$$

GNI/capita in current USD (2009) and (2013) was used to estimate and disaggregate the average cost in intervals around the averages. The annual investment cost per extension advisor was estimated at USD 4 000 to 6 000 for low-income countries, USD 6 000 to 9 600 for low-middle-income countries and USD 9 600 to 14 400 for upper-middle-income countries, based on the World Bank classification of the developing countries. The GNI/capita bracket values are updated annually. Results of the cost calculation were triangulated with purchasing power parity (PPP) inflation of each country based on 1999 cost data. The derived costs per extension advisor included personnel costs, and costs for reform and capacity development, operations and for programmes benefitting smallholder producers, as well as costs for monitoring of the EAS system.

'**Total expenditure on EAS**' $[\chi_x]$, i.e. the national investment requirement, is determined by the estimated '**required number of extension advisors**' $[\Psi_x]$ times the '**country specific cost per advisor**' $[C_x]$ derived from the model.

$$\chi(\text{x}) = \Psi(\text{x}) \times C(\text{x})$$

<div align="right">[Eq.4]</div>

The climate change scenario shows an increased investment requirement due to the countries' vulnerability to climate change. Therefore a lowered upper interval (Max=1 500 instead of 2 000) of the agent ratio is used to adjust the increased need and cost of EAS. We collected agriculture-related climate vulnerability information on countries by selecting agricultural policy related sub-indices from the 'Environmental Vulnerability Index' (EVI) (SOPAC, 2004):

> (i) climate change;
> (ii) agriculture and fisheries;
> (iii) renewable water; and
> (iv) desertification.

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Each is composed of several climate change vulnerability indicators. The authors calculated an Agricultural Climate Change Vulnerability Index (ACCVI) from the sub-indices by taking the maximum value of the agriculture-related sub-indices in order to identify and focus on the factors most limiting for agriculture (e.g. renewable water; desertification). The same approach was used to identify limiting factors to agriculture from among soil, climate and water scarcity, and link resource endowment to poverty. The ACCVI was then used as a multiplier to the 'average cost per advisor' in the baseline scenario that increased the cost of EAS investment by 2–6 percent, depending on the country-specific value. (Blum and Szonyi, 2014)

The second component of the study in 2014 gives an extra dimension in terms of space and time to the first study. It extended the number of countries that participated in the studies to about 130 developing (both low- and middle-income) countries, of which 117 had sufficient macro-economic data to participate in the study. About 80 countries had sufficient data from both 2009 and 2013 for policy impact scenarios and country comparisons.

The source of data for the 2014 study is solely the World Bank (2013) database, while the AgGDP values were projected based on the FAO database in 2009. Since the global database in 2013 no longer provided data on radio ownership, information access was calculated only from the data on mobile and internet subscriptions, without the radio, but the weighted average used equal weight for the information access component in both studies.

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CHAPTER 3
STUDY RESULTS

Throughout the study we distinguished two main scenarios. The baseline scenario is the minimum required investment, which countries must meet for a sustainable development path, while the climate change scenario provides an increased estimate to meet additional challenges to adapt practices to risks from weather variability and climate change.

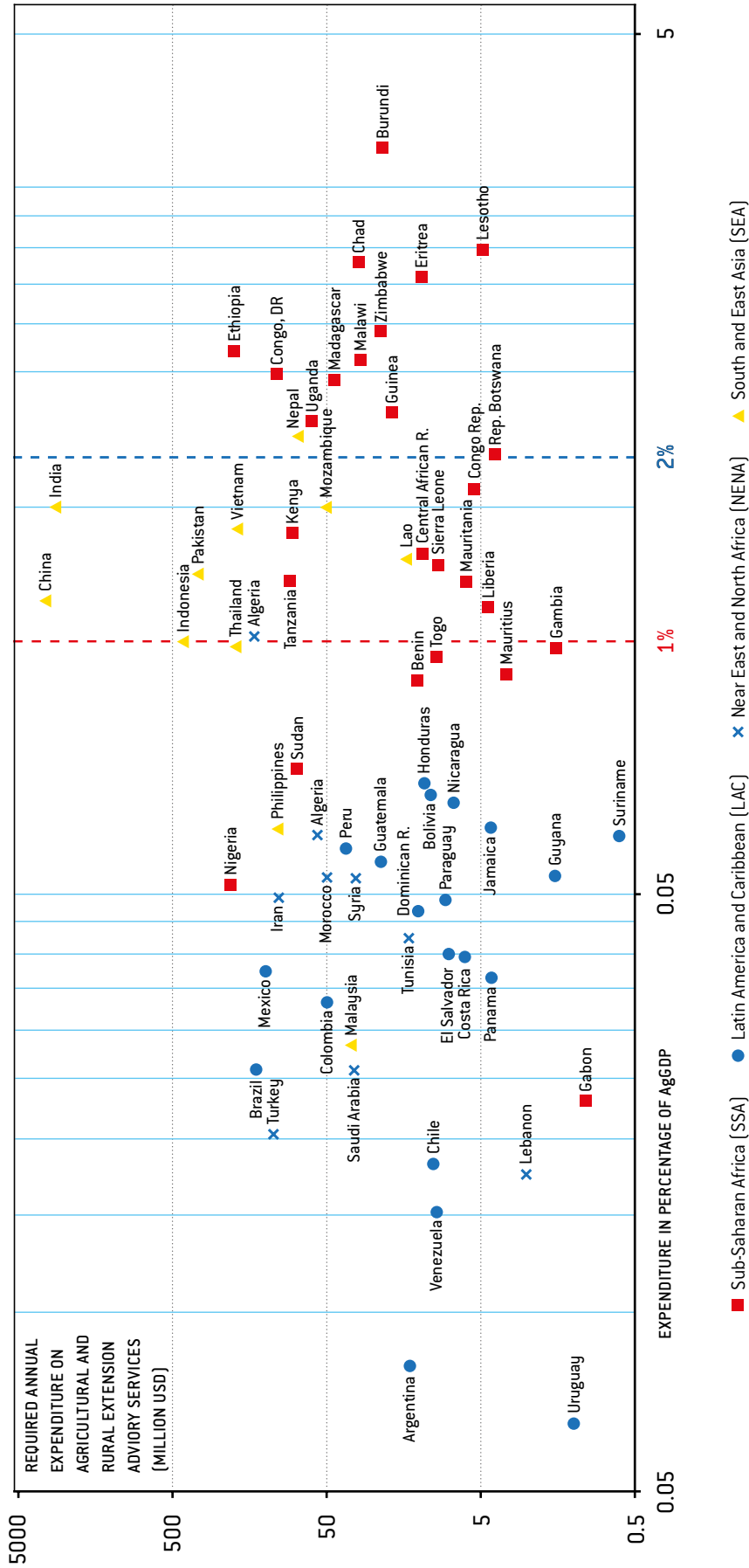## 3.1. REGIONAL DIFFERENCES IN INVESTMENT REQUIREMENTS

By observing the model results (Figure 1), the annual investment requirement in USD values plotted against the value of the required investment as a percentage of the AgGDP, a clear pattern emerges of inter-regional economic disparities. Most of the countries that require more than 1 percent of their AgGDP investment are from the South East Asia and Africa regions, and many developing African countries would lack development even with 2 percent AgGDP investment. Countries of South America and North Africa need to invest mostly between 0.4 and 1 percent of their AgGDP.

An interesting trend emerges when comparing the 2009 and 2013 results (Table 1). The EAS investment requirement model is driven by changes in population, development parameters (poverty, nutrition) and information technology infrastructure. Despite steady population increase, the SEA and NENA regions reduced their investment requirement in 2013 compared to the baseline in 2009, driven by advances in reducing poverty (except war-torn conflict countries) and improved ICT.

Investment requirement in EAS in terms of percentage of agricultural GDP (investment intensity) was an average of 1.91 to 2.59 percent in 38 countries in Sub-Saharan Africa in the baseline zero hunger and climate change adaptation scenarios, respectively, in 2009. Yet individual country results showed significant differences, with lowest investment requirements in Gabon and Nigeria and highest in Burundi and Lesotho. The investment requirement increased to an average of 2.21 percent and 2.64 percent in the baseline and climate scenario, respectively, in 2013.

The average investment in EAS was 1.45 to 2.16 percent of AgGDP in 16 countries in South and East Asia (SEA) - with the lowest share in Malaysia and South Korea and the highest in Nepal and Bangladesh. The 2013 data shows 6.25 percent lower investment requirement, with the highest savings in Bangladesh. The overall EAS investment requirement decreased to 1.36 percent in the baseline and 1.75 percent in the climate scenario in 2013.

Figure 1. Results of the minimum annual EAS requirement (baseline scenario) in 2009

REQUIRED ANNUAL EXPENDITURE ON AGRICULTURAL AND RURAL EXTENSION ADVIORY SERVICES (MILLION USD)

EXPENDITURE IN PERCENTAGE OF AgGDP

■ Sub-Saharan Africa (SSA)   ● Latin America and Caribbean (LAC)   ✕ Near East and North Africa (NENA)   ▲ South and East Asia (SEA)

First published in Blum and Szonyi, 2014

Table 1. **Regional comparison of investment requirement in Agricultural and Rural Extension and Advisory Services (EAS)**

Region	EAS Investment Requirement (as % of AgGDP) Baseline and Climate Scenario 2009	Change in investment requirement Baseline 2013 (Compared with Baseline 2009)	Change in investment requirement Climate Scenario 2013 (Compared with Baseline 2009)
Sub-Saharan Africa (SSA)	1.91% – 2.39%	+15.61%	+38.58%
South East Asia (SEA)	1.45% – 2.16%	-6.25%	+20.57%
Near East and North Africa (NENA)	0.54% – 0.88%	-2.82%	+26.63%
Latin America and the Caribbean (LAC)	0.44% – 0.68%	+15.91%	+49.33%

Key to countries:

SSA countries: Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo Dem. Rep., Congo Rep., Cote d'Ivoire, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Kenya, Lesotho, Liberia, Malawi, Mali, Mauritania, Mauritius, Mozambique, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe;
SEA countries: Afghanistan, Bangladesh, Cambodia, China, India, Indonesia, Lao PDR, Malaysia, Nepal, Pakistan, Philippines, Sri Lanka, Thailand, Viet Nam;
NENA countries: Algeria, Egypt, Jordan, Lebanon, Morocco, Tunisia, Turkey;
LAC countries: Bolivia (Plurinational State of), Brazil, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, Venezuela (Bolivarian Republic of)

In 10 countries of the Near East and North Africa (NENA) region, average investment requirement was 0.54–0.88 percent of the AgGDP - with lowest share in Lebanon and Turkey and highest share in Egypt and Jordan. It slightly decreased to 0.52 percent and 0.68 percent in the baseline and in the climate scenarios, respectively, in 2013.

In 20 countries of Latin America and the Caribbean (LAC) region, the average investment intensity was 0.44–0.68 percent of the AgGDP, with the lowest share in Argentina and Uruguay and the highest share in Bolivia (Plurinational State of) and Honduras. Argentina, Chile and Uruguay were not included in the 2003 study, because according to their GNI/capita they moved up to high income countries (World Bank Statistics, 2014). This increased the average investment to 0.51 percent in the baseline and 0.66 percent in the climate scenario in 2013.

Evidently, countries of the LAC and NENA regions can afford to spend below 1 percent of their AgGDP due to their relatively higher average income per agricultural labourer, and most of SEA and SSA countries should invest between 1 and 3 percent (with some cases of 4 percent or more) of their respective AgGDP: for example Burundi, Chad and Lesotho in both the zero hunger and climate scenarios, and Eritrea, Malawi and Zimbabwe in the climate scenario. Congo and Ethiopia are just marginally below 4 percent.

Some countries with insufficient data (e.g. Haiti, Somalia and Syria) would also be in this group according to this paper's authors. These countries are often characterized by more pervasive and deeper poverty.

3.2. POVERTY, UNDER-NOURISHMENT AND ICT TRENDS

Re-visiting figures on the need for EAS financing requires a review of the dynamics of the main factors that drives the demand for EAS services. The World Bank uses GNI per capita to classify developing countries in low, lower-middle income, and upper-middle income categories. The income gap between the average LAC and NENA regions and the average SEA and SSA regions almost doubled in the last twenty years (Figure 2).

**Figure 2.** **GNI per capita, PPP (current international USD)**
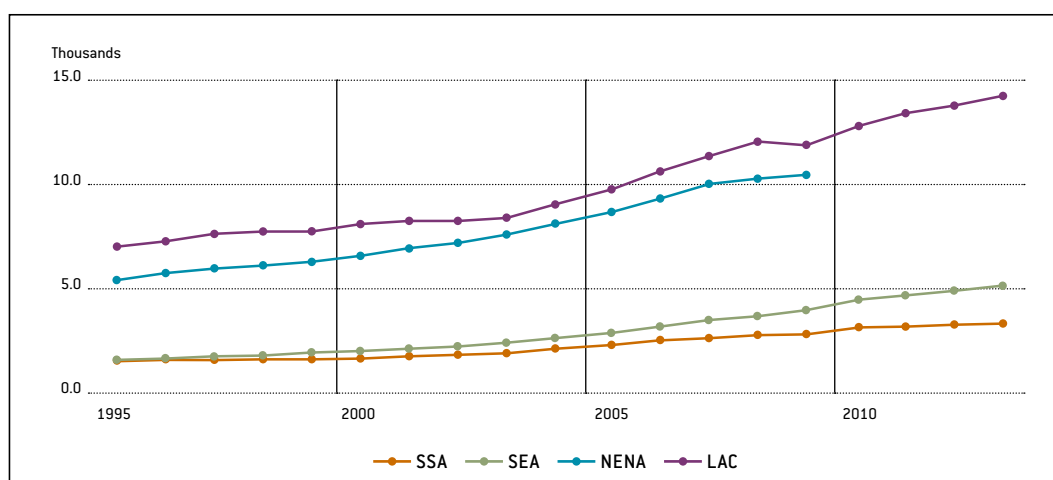
Source: World Bank, 1995−2015

In order to compensate for the fact that the GNI per capita figure does not provide information on income inequalities, we introduced two other indicators, 'under-nourishment in percent of the population' and 'percentage of people living below the poverty line'.

While South East Asia and Africa are lagging behind in economic development, there were important achievements in reducing under-nourishment (Figure 3) and in reducing the number of people living below the poverty line[2]. The prevalence of under-nourishment as a percentage of the population improved from 32 percent to 22 percent in Africa, and was reduced from 26 percent to 17 percent in South East Asia.

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[2] The 'percentage of people living below the poverty line' data is not shown as a graph, because of the lack of historical data.

Figure 3. **Prevalence of under-nourishment (percent of population)**
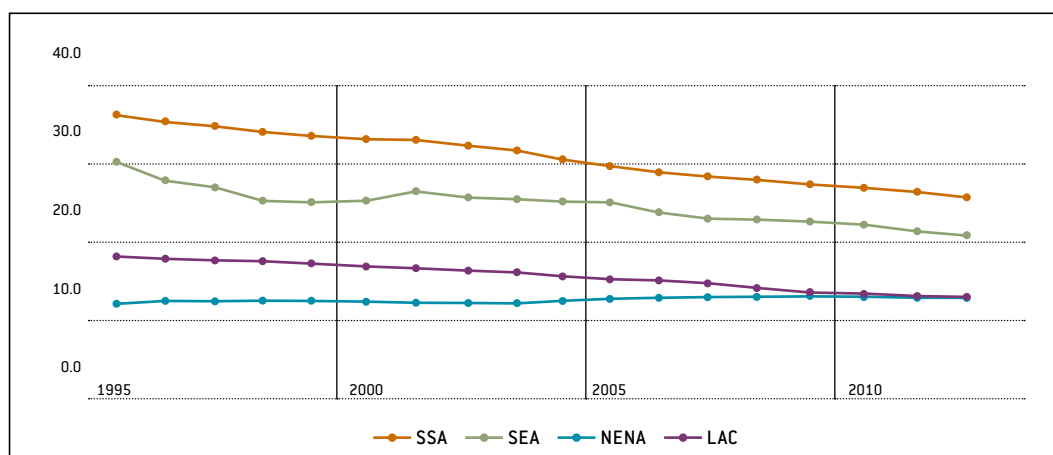
Source: World Bank, 1995–2015

Information and communication technologies (ICTs) are increasingly accessible and affordable in the developing world. ICTs have made an undeniable contribution to the MGDs and will also make it to the SDGs (The Earth Institute/Ericsson, 2016). Mobile and computer technology supports agricultural development through improved market efficiency, increasing employment and other economic opportunities for the poor. It improves access to credit, and mitigates the risk of a failing business. ICTs can help in identifying resources and mapping patterns for better decision-making (The Earth Institute/Ericsson, 2016), gather quick information for targeted action, support accountability and transparency, and improve information management. ICTs can improve the efficiency of community decision-making (The Earth Institute/Ericsson, 2016), help identify vulnerable groups (e.g. poverty mapping (Szonyi *et al*., 2010), AIDS virus mapping (UNAIDS. Online) and improve disaster management (e.g. earthquake in Haiti (Meier, 2012). ICTs also provide early warning systems (e.g. global wheat rust monitoring system (FAO, 2011) and Tsunami warning in South Asia and the Pacific (PTWC, 2009).

There are many potential improvements for capacity development, e.g. through virtual classrooms, distant learning, videos. Community decision-making also benefits from capacity development through information access, and more efficient EAS services lead to improvements in rural livelihoods. Theoretically, more efficient ICT-supported EAS systems are more cost effective and require fewer extension advisors for the same population.

According to 2013 data (World Bank database, 2014) the number of internet users increased to 46 percent of the population in Latin America, 34 percent of the population were connected in the Near East and North Africa region, while there is great potential still for Sout East Asia (17 percent of the population connected), and 14 percent of the population had internet access in Africa.

Figure 4. Internet users (per 100 people): a regional comparison
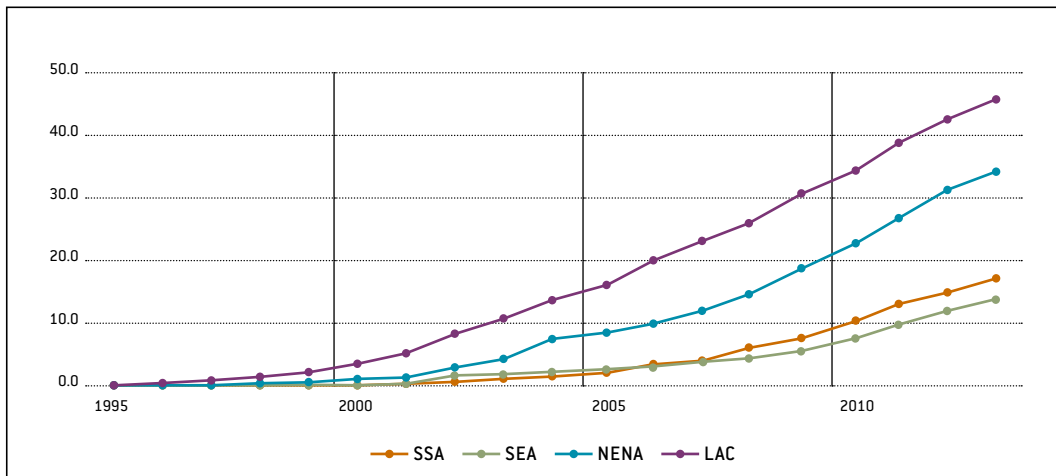
Source: World Bank statistics 1995–2015

The mobile phone revolution that overtook, in terms of speed, the internet revolution in several areas of the world, shows similar patterns, with an even steeper development curve, LAC and NENA regions had respectively 114 and 101 subscribers per every 100 people (where often most people own more than one simcard). The mobile revolution was extraordinary in South East Asia and Africa, which were lacking infrastructure for 'traditional landline telephone access' and development of communication relied solely on mobile technology.


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In the developing world, prior to the introduction of mobile phones, farmers, traders, and consumers had to travel long distances to markets, often over very poor roads, simply to obtain price (and other) information. Such travel imposes significant costs in time and money. Based on the assumptions of our model, connectivity and access to information through mobile devices would decrease to some extent the need for face-to-face EAS services. Open access technologies and agricultural public goods will increase in popularity.

Mobile phones and internet reduce the cost of information and allow farmers and traders to better respond to surpluses and shortages, thereby allocating commodities more efficiently across markets and dampening price differences. Mobile phone coverage also increased traders' profits and decreased the volatility of prices over the course of the year.

Figure 5. Mobile cellular subscriptions (per 100 people): a regional comparison
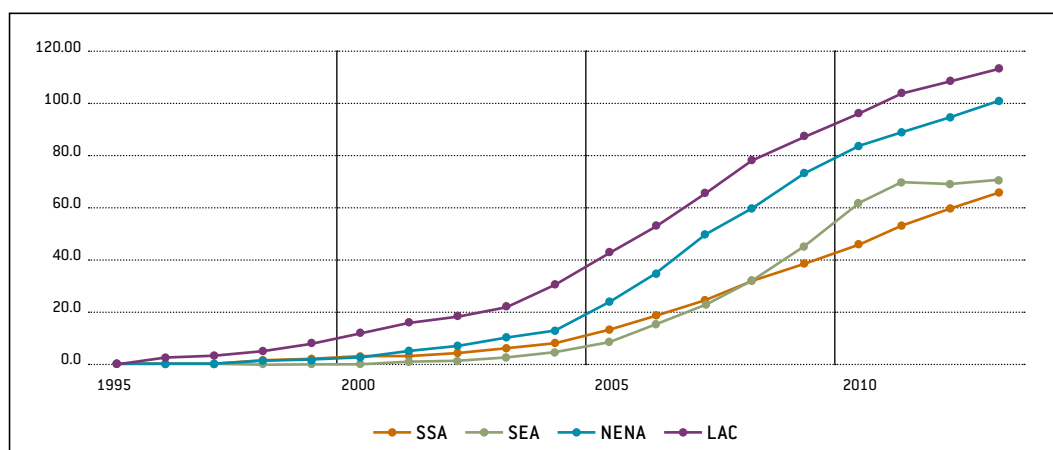
Source: World Bank statistics 1995–2015

Though simplified for the model, the most important parameters to determine the need for EAS are population, population density, poverty, nutrition, and information access.

3.3. IMPACT OF POPULATION, POVERTY AND ICT CHANGES ON EAS INVESTMENT REQUIREMENTS

The model uses population density as one of the parameters to define demand for EAS. There is reverse correlation between population density and EAS need. In countries with high population density, e.g. Bangladesh, extension advisors spend less time travelling and EAS services are dealing with larger groups of farmers. Therefore population density directly affects the parameters of the EAS Demand Indicator.

The population density is 14 people/km^2 land area in Niger and 191 people/km^2 in the neighbouring Nigeria (World Bank, 2014). After considering differences in poverty and information access, we also derive a staff ratio. The number of farmers served by 1 extension advisor is 809 in Niger and 1386 in Nigeria. The staff ratio is multiplied by the EAS demand, the number of active agricultural population, to derive the number of extension advisors in the countries. The number of extension advisors, based on the EAS model, are 18 000 in Niger and 65 500 in Nigeria that would be required in 2013 to achieve the MDGs/SDGs.

The steep ICT development curve in SSA and SEA provides the opportunity for a "second green revolution" or "IT revolution" to improve socio-economic development. An update of the macro-economic data of the EAS database allows us to show how results change based on improved infrastructure and information access.

In the 2009 study (Blum and Szonyi, 2014) we calculated hypothetical scenarios for the impact of ICTs. The update of the database for the 2014 study allows us to compare those projections in space and time with new results. Based on 2009 data, we forecasted for Bangladesh, that an increase of the average information access from rank (14) to rank (40) (average ICT rank of Pakistan and Sri Lanka in the region) and 40 percent reduction in the poverty headcount ratio would lead to USD 73 million annual saving in EAS expenditure. Comparing 2009 and 2013 data reveals the rural poverty headcount was cut by 50 percent, mobile subscription almost doubled from 35 to 67 subscribers per 100 people, driving the average information technology ranking up from 12 to 24. These improvements contributed to USD 70.5 million annual saving as the EAS investment requirements were USD 394.4 million in 2009 and USD 323.9 million in 2013.

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The fastest adoption rate for information technologies exceeding 100 percent growth (based on the averaged internet and mobile subscription in 2009 and 2013) were observed in Nepal, Yemen, Cambodia, Mali and Congo Republic. In Yemen, the improvement in information access was offset by increased poverty and hence resulted in an increased EAS investment requirement of 6.4 percent (USD 3.63 million). In Mali, information access increased and poverty reduced, both resulting in a reduced EAS investment requirement of about 20 percent (USD 5.6 million).

18 of 80 countries with both 2009 and 2013 data reduced their annual EAS expenditures, due to ICT improvement, and improvements in socio-economic data (Figure 6).

Negative growth can be observed in the average ranking score for those countries that were slower in developing ICT infrastructure, and many faster growing countries overtook them. This resulted in negative growth for countries (from lowest), e.g. Eritrea, Burundi, Congo Democratic Republic, Ethiopia, Sierra Leone, Tanzania, Madagascar, Malawi, Togo and Mozambique. The consequence of such negative ICT growth is an increase in the EAS investment requirement: In some countries, this was aggravated by population and/or poverty growth (e.g. Eritrea with 71 percent and Congo (DRC) with 50 percent increase in EAS investment requirements), while in other countries, reduced poverty kept the increase in EAS investment requirements at lower levels (e.g. Malawi with 11 percent; Tanzania with 12 percent and Ethiopia with 13 percent).

Countries from South East Asia realized the largest amount of savings: China (USD 184 million), Bangladesh (USD 70 million), India (USD 44 million) and Thailand (USD 40 million). Thailand had the greatest savings in percentage terms of their annual extension requirement in 2009 (21 percent) followed by Mali (20 percent).

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Figure 6. Changes in EAS investment requirements (USD million and percentage) between 2009 and 2013

Sub-Saharan Africa

CHANGES IN %   CHANGES IN USD

South East Asia

CHANGES IN %   CHANGES IN USD
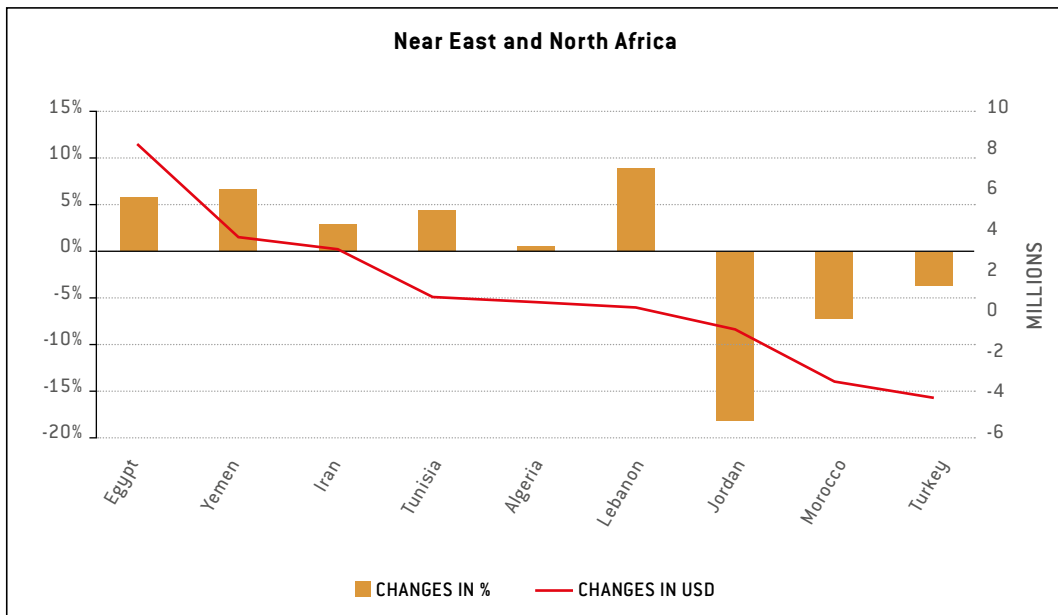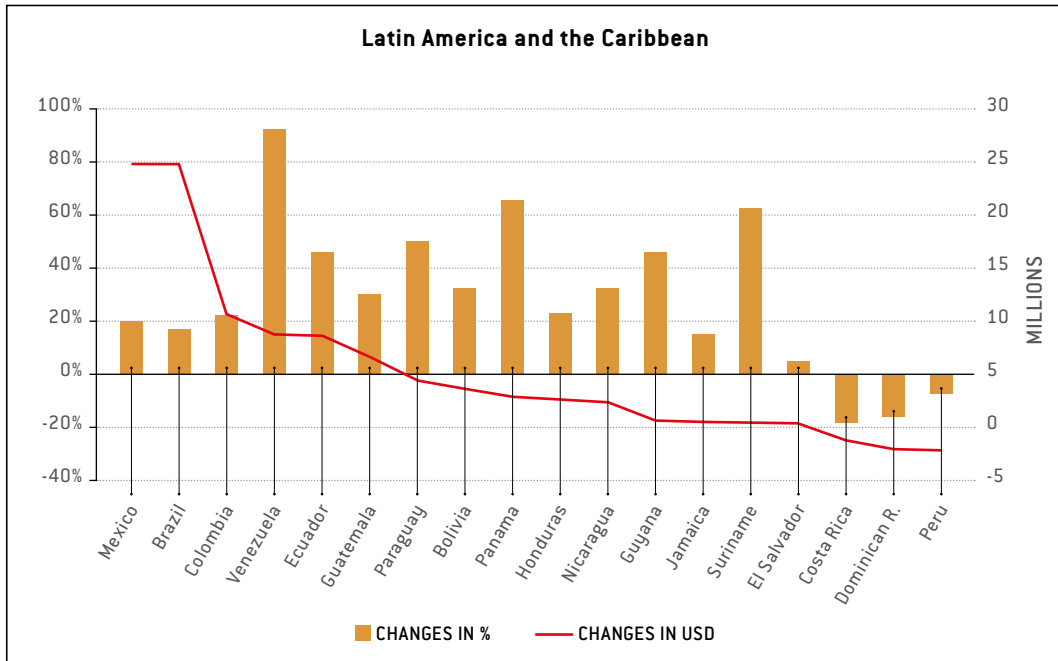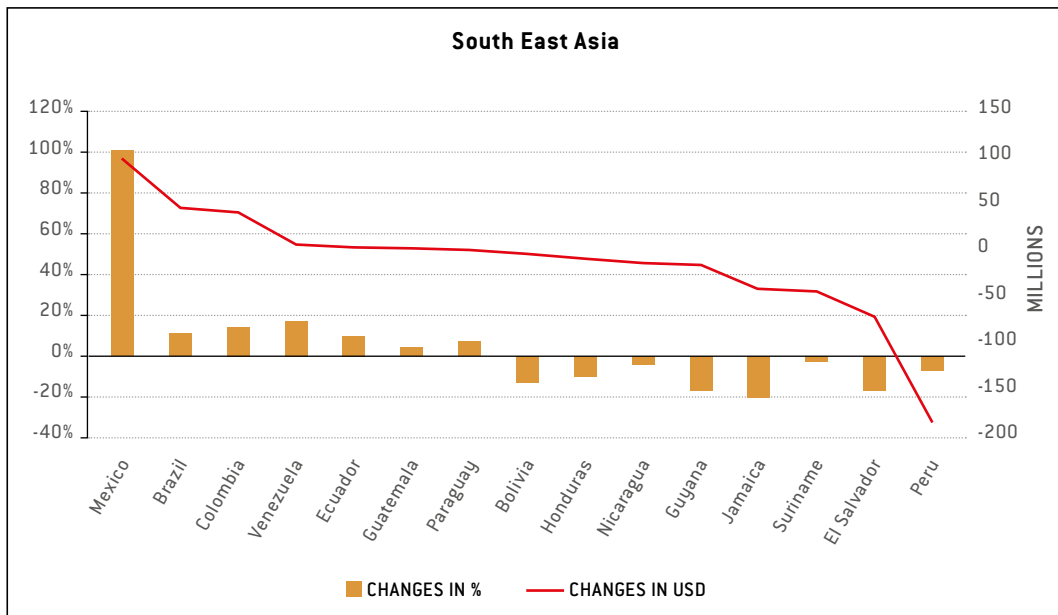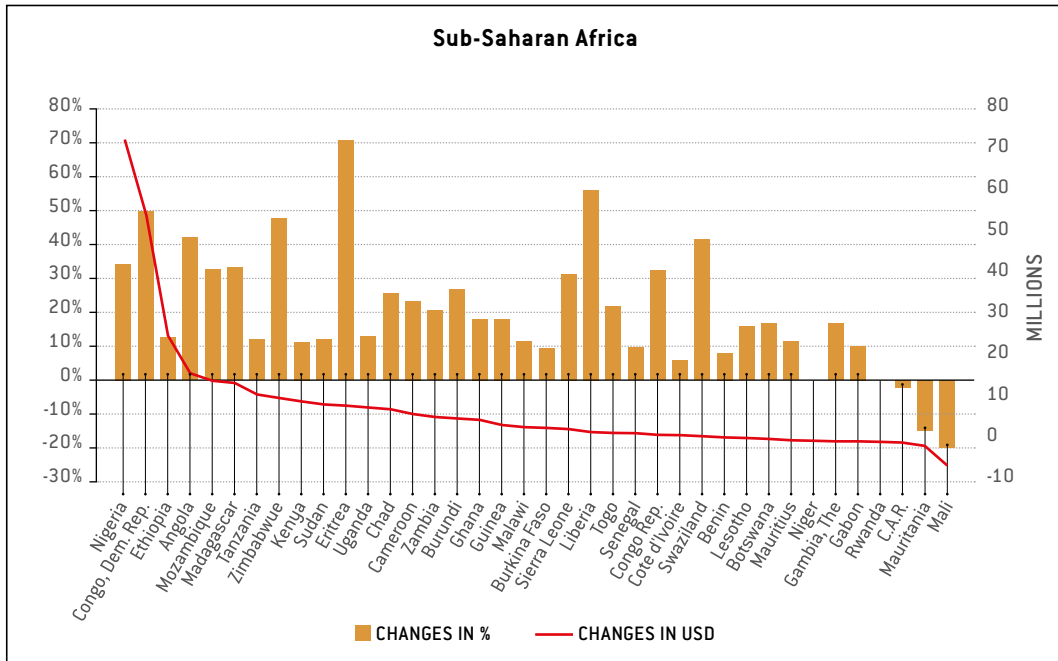
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CHAPTER 4
CONCLUSIONS

Our research suggests that most low-income countries need to increase financial commitments in order to meet their rural development, poverty and climate change challenges and objectives, especially in the African and East Asian region. The amount of financial commitment or annual expenditure on agricultural and rural EAS would decrease as a result of investment in poverty alleviation, ICTs, reducing population, etc. Research supports that ICT drives socio-economic development and leads to improved livelihood.

In many low-income countries, public investment has often been reduced to paying salaries of the public extension agents, which is not a sufficient investment to achieve zero hunger. Investments in promoting pluralism of EAS and a market of EAS providers and in developing EAS related programmes that benefit smallholders are required. The quality of spending is as important as the overall quantity of spending. Additional investments should be focused on the priority investment areas of information, technology and market access (including infrastructure), with capacity development for EAS to increase efficiency and effectiveness. The last-named depends on key factors relating to governance and management structures of the advisory system, its capacity and flexibility to respond to the diverse and changing demands of smallholders, to link to other stakeholders within the agricultural innovation system and to the policy environment.

An increasing proportion of EAS is now being carried out by non-public service providers (NGOs, farmer organizations, private enterprises). This requires public investments in non-public EAS, particularly when these services are addressing non-profitable poverty and climate change objectives. Private investments should also be encouraged to finance agricultural and rural EAS in an innovation framework. These include new cost-sharing arrangements in which farmers and their organizations pay a part of the service costs, depending on their capacities, for strengthening relevance and accountability of EAS to them. In the upper-middle income countries successful examples show a transition to the 'who benefits pays' practice; in poorer countries such a strategy needs to be subsidized with financing mechanisms supporting the demand side, i.e. farmers and their organizations.

In the least-developed countries, public investment should be promoted in conjunction with development programmes that support extension and advisory services. Development aid can supplement the investment efforts of poor countries. A 1 percent AgGDP investment by the country could be topped up to reach the required investment target and would balance the

investment efforts required to fight hunger and poverty between lower- and higher-income countries. Such a support would greatly help the least developed countries in reaching the SDGs.

In this study the investment requirement calculations are based on the required number of extension advisors (public and non-public) multiplied by the cost per advisor (including all EAS related costs). This is used as a proxy to estimate the overall EAS investments required for all EAS services (public, private, civil society) in the country. However, the derived number of extension advisors should not be directly used for planning of EAS advisors, as the specific local socio-economic and agro-ecological conditions must also be taken into account.

The model could not accommodate investment differences, which would occur between EAS advising individual farmers, compared with those advising groups and producer organizations (POs). Data are not available on the number of POs and their organizational capacities. However, we can assume that the difference between these two approaches is significant in terms of outreach and impact. Hence, the promotion of POs should not only reduce EAS investments, but would also increase PO capacities:

1. to identify and demand their priority advisory needs;
2. to provide EAS services (e.g. farmer-to-farmer approaches, employment of extension advisors by cooperatives);
3. in jointly accessing information, knowledge and markets; and
4. to participate in decision-making related to innovation, research and EAS policies and investments.

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There is need for more reliable EAS and investment data and more regular and sustainable data collection and EAS investment mapping in the countries. National EAS platforms composed of the diverse service providers (public, NGOs, POs and private enterprises) could contribute substantially to overcoming this information gap. Better data would contribute to increasing the precision of the model's results and its recommendations for policy formulation. The methodology used in this type of investment assessment could benefit from the results of EAS impact assessment studies that identify key parameters (e.g. information access and poverty) and their relative contribution (weights) to the EAS investment requirements, e.g. an econometric model could re-define the weights of the selected parameters that we used in the study for poverty (1), information access (2), and population density (3).

Further research is required on how an extension and advisory systems could be transformed in order to make investments more effective and cost efficient. Reform and transition of the extension systems towards pluralistic demand-led and market-oriented advisory systems often require shifting to private or commercialized services, to modern sharing of knowledge and information using ICTs, with improved market access and a more prominent role of farmer organizations in EAS governance, including their participation in policy formulation and investment decisions, as well as EAS provision by them. However, little is known about the link between various financing mechanisms, the effectiveness of investments and the way EAS systems are organized and the different dynamic and flexibility this creates.

This also holds true for the different ways of investing in extension and advisory services. Most investments finance the supply side of EAS, i.e. the EAS services, but very little is invested into the demand side of EAS, i.e. into the users of EAS and the farmer organizations' capacities to articulate their demand, to pay for the services they want, and to play their roles in EAS systems and services. Research is required on new financing mechanisms, particularly the testing of pull mechanisms: i.e. financing mechanisms of the demand side of EAS in order to see its effect on demand for EAS, not only on effectiveness and efficiency of EAS, but also on empowerment of smallholders and their satisfaction with the advisory services they are receiving.

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EVOLUTION OF COUNTRY-SPECIFIC INVESTMENT REQUIREMENTS OF AGRICULTURAL AND RURAL EXTENSION AND ADVISORY SERVICES

OCCASIONAL PAPERS ON **INNOVATION IN FAMILY FARMING**

AGRICULTURAL INNOVATION IN FAMILY FARMING

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The Sustainable Development Goals (SDGs) strongly pursue poverty and food security goals. One of its indicators calls for increased investment, including investments for agricultural research and extension services, etc. This paper is based on a model developed by the authors to calculate the investment requirements for agricultural and rural extension and advisory services (EAS) based on macro-economic data of developing countries. The model reveals significant differences in average investment requirements in different regions and shows the additional EAS costs related to climate change and other areas that currently lack investment.

The model was updated with 2013 data and then compared with 2009 data in order to provide case studies or 'success stories' for development. Dynamic investment scenarios compare country-specific socio-economic macro-indicators for poverty, information access, and population density with the 4-year lag in order to highlight the impacts on investment. Of the 80 countries that took part in both studies, 18 realized reduced annual investment requirements for EAS as a result of improvement variously in internet access, mobile subscription or achievements in food security and poverty reduction.