AGRICULTURAL EXTENSION SERVICES
IN NICARAGUA, HONDURAS AND EL SALVADOR

Global Water Initiative
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Created by
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1. Introduction to the Topics for Debate Series

Agriculture represents the main source of livelihood for much of the rural population living at or near poverty levels. For many developing countries, agriculture is also a driving force for general economic growth, and therefore a means to poverty reduction. The demand for food and forage continues to increase throughout the world[1]; this demand will be met by improving productivity. In Central America, this means diversifying crop cultivation on small plots of land at a time when climate change and price volatility are the norm.

The situation in Central America is a mirror of what is happening in other regions of the world. As such, development have concluded that "rain-fed agriculture remains the main source of food, feed and fiber worldwide, particularly in areas where rural livelihood systems prevail"[2].

1.1. Food insecurity in Central America

After almost half a century of constant decrease in the prices of food commodities, it is now anticipated that prices will remain unstable throughout the next decades[3]. The rise in food prices during 2008 and 2011 demonstrated how market volatility affected worldwide food security[4].

Food prices have a direct effect on the poverty of the region given the fact that food represents the largest percentage of family budgets in Central America, both for urban and rural families[5]. Numbers show that 1.1 million people fell into poverty, while another two million already living under the poverty level descended further into extreme poverty conditions[6].

The price crisis shook Central American economies to the core, given the fact that the countries in the region import approximately 40% of their food supplies[7]. That condition makes them particularly vulnerable. Production of basic grains only improved 2.5% per year between 2000 and 2009, barely keeping up with the growth rate of the local population[8]. Therefore, with a constantly growing demand for food and a national production dependent on imports, in the short term the region will find itself more and more vulnerable to global market instability.

1.2. Environmental degradation in Central America

Two of the most critical environmental issues being faced by Central America are soil degradation and water pollution; both problems exacerbated by climate change. Central America is naturally susceptible to soil erosion due to its topography: 70% of its territory is comprised of hills. And the situation is further compounded by

1. During the course of the next 40 years, agriculture will need to double its food, fiber and fuel production to cover the increasing demand created by a growing world population, better economic conditions, as well as changing consumption patterns and lifestyles. Some projections (FAO 2009) suggest that production will need to be increased by approximately 70% by the year 2050 just to keep up with expected food demand.

2. Translation from GWI. Molden, D. (ed.) (2007): Water for Food, Water for Life: Comprehensive Assessment of Water Management for Food. Earthscan, London.

3. Note: Global grain prices are strongly correlated with the cost of oil. Visit: http://www.paulchefurka.ca/Oil_Food.html.

4. FAO (2011) Addressing high food prices: A synthesis report of FAO policy consultations at regional and sub regional level. Rome, FAO October, 2011

5*. Food and nutrition insecurity in Latin America and the Caribbean.CEPAL, 2009.

6*. CEPAL (2008) Central American Isthmus: Global Crisis, Challenges, Opportunities and New Strategies

7. IICA (2011) The Food Security Situation in the Americas. Page 15. http://www.iica.int/Esp/Programas/SeguridadAlimentaria/IICAPublicaciones/B2914i.pdf.

8. Based on data provided by the FAO, grain production increased by 2.56% and general food production increased by 4.3% during the decade preceding 2009. Reported by IICA (2011) The Food Security Situation in the Americas.

the expansion of the agricultural frontier into natural ecosystems, as well as the continuing custom of burning the land to prepare it for planting[9]. These changes in land use practices have caused heavy environmental degradation in the past 50 years[10].

The productive capacity of agriculture in the region has been affected by the widespread degradation of agricultural lands and river basins. It is estimated that approximately 80% of the land destined for agriculture has been affected by man-induced soil degradation, this being the highest percentage of all the regions throughout the world. Central America is the only region worldwide where improper farming practices have been the main cause of soil degradation, even more so that deforestation itself (Oldeman et al., 1991; Zurek, 2002). The severely degraded Central American soils also cause massive water resource loss. Instead of infiltrating and being used in plant transpiration to produce biomass, the water is lost as run-off.

At the same time, climate change is predicted to reduce agricultural production by at least 15% in Central America[11]. In the last two decades, climate patterns in the region have changed considerably. These changes are clearly evident in: (a) the increase of average temperatures; and, (b) the frequency and intensity of storms and droughts. The net impact of the increase in temperatures is hard to measure; however, some studies in the last few years have proven that two types of rain-fed crops which are pivotal to the region, coffee[12] and corn[13], will be negatively impacted by this situation.

The impact of more frequent and intense storms on agricultural production is difficult to predict, given the uncertainties of the climate. But impacts are already evident in the region. Extreme climate events are increasingly frequent since the 1960's. These storms have immediate and long-term effects on agriculture. In the short term, the rains and winds cause crop damage. In the medium and long term, extreme rain accelerates soil erosion and produce reduced soil fertility for future growing seasons.

1.3. Rain-fed Agriculture: Challenges and opportunities

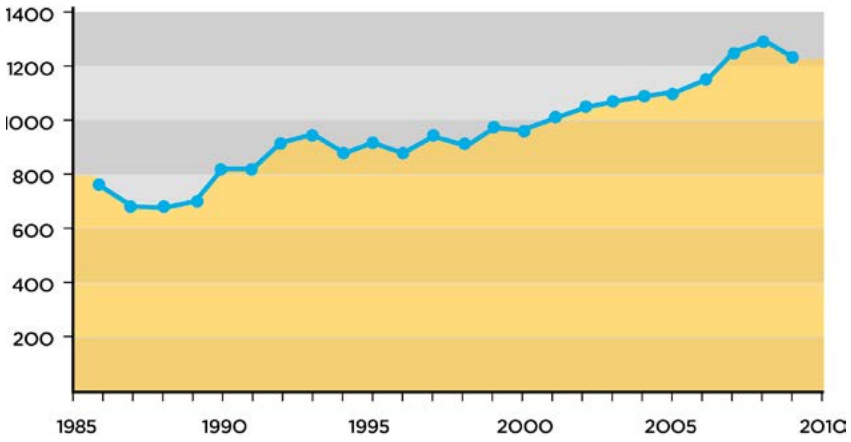
In Central America, small-scale rain-fed agriculture produces 2/3 of the food while occupying over 80% of the agricultural lands in the region[14]. However, with this type of agriculture, countries face three persistent and closely intertwined challenges: food insecurity, poverty and environmental degradation. Rain-fed agriculture, or that which depends solely on rain, is practiced mainly by small farming families. That characteristic is a fundamental part of the problem as well as a key to its solution. A clear strategy to improve food production and food security within the region is to increase the productivity of family farms. The current state of degradation of farming land in Central America due to severe mismanagement of soil and water, represents not only risks and added vulnerability, but also the opportunity to produce more food with less freshwater resources (Rockström, 2007). Improving water productivity then becomes a critical answer to land mismanagement, as well as being able to provide sufficient water for ecosystems and satisfy the growing demand of cities and industries (Molden y Oweis, 2007).

9. Review: Bossio, D. y Geheb, K. (2008) Conserving Land, Protecting Water. Comprehensive Assessment of Water Management in Agriculture, Series 6. CAB International.
10. Millennium Ecosystem Assessment (MEA). Ecosystems and Human Wellbeing: Synthesis. Washington, D.C.: Island Press. 2005.
11. CEPAL (2014) Potential Impact of climate change over basic grains in Central America.
12. CGIAR and CRS (2010). Coffee Under Pressure: http://www.slideshare.net/ciatdapa/2009-03-18-coffee-under-pressure-cup-ciat-sfl-meeting.
13. TOR Report (2012) Tortillas on the Roaster, Summary Report: CIAT, CIMMYT, and CRS. http://newswire.crs.org/wp-content/uploads/2012/10/CRS_Tortillas_on_the_roaster_summary_report.
14. Siebert y Doll (2010) Quantifying blue and green virtual water contents in global crop production as well as potential production losses without irrigation. Journal of Hydrology. Vol. 384. Also see: FAO (2014). Family agriculture in Latin America and the Caribbean: Policy recommendations. These numbers belong to global scale numbers: 80% of farm lands in the world are irrigated with rainwater and produce 62% of basic food in the world (FAOSTAT 2005) as reported by Rockström, J. (2007): Unlocking the potential of rain-fed agriculture. Chapter 8: Managing water in rain-fed agriculture. IWMI.

There is great potential to improve crop yield through the productivity of water in rain-fed agricultural systems. The positive effect of innovative agronomic and water management practices have already been demonstrated. There are considerable variations within rain-fed agriculture in Central America, which highlights existing challenges and opportunities to increase rain-fed production. Average corn yield is currently below 1,500 kg/ha (see figure 1) [15]. A conservative yield goal should be of 3,000 kg/ha for corn grown on hillside farms[16].

Evidence shows that in semiarid, sub-humid regions, as well as in dry sub-humid areas, the biggest challenge to water for rain-fed agriculture is the extreme variability of rainfall, marked by rainfall events, high intensity storms and an increasing frequency in droughts and dry periods. In Central America there is a short dry period in the midst of the rainy season, locally referred to as "canícula" (summer heatwave). This common dry spell may very well be the single most serious climate risk factor for farmers, and given it's severity, represents an important factor in all planting decisions each season. When the canícula is longer and drier than usual, it threatens the crops in both planting cycles, the first and second (postrera).

Figure 1: Estimate of average corn yields in CA4 countries (1985-2010).



Sources: FAOSTAT (2012), RedSICTA 2011 and analysis conducted by Hileman, J. (2012)

1.4. Good practices in rain-fed agriculture

During the last decades there has been an enormous amount of analysis and learning about sustainable agriculture, There have been advances in training and education that have proven effective to incentivize small farming family to improve their agricultural practices. There are many success stories, at both a smaller and greater scale. Better practices for sustainable agriculture are described as "Water-Smart Agriculture" [17]. The GWI initiative is currently promoting "Water-Smart Agriculture" in rain-fed systems in Central America[18].

15. Data provided by FAOStat (2012), RedSICTA (2011). However, official statistics combine data from irrigated and rain-fed farm lands, hence the figure shows the productivity of corn irrigated with rainwater on the basis of a statistical analysis of corn in the region conducted by J. Hileman 2012 (unpublished material).

16. Turrent, A., et al. (2012) Achieving Mexico's Maize Potential. Global Development and Environment Institute. Work document No. 12-03.

17. Turrent, A., et al. (2012) Achieving Mexico's Maize Potential.Global Development and Environment Institute.Work document No. 12-03.

18. TOR Report (2012). The TOR report concludes that"improving soil fertility and its management at a large scale can represent the most important adaptation technique towards climate change available to small farmers in Central America".

1.5. Reinvesting in rain-fed agriculture

During the past twenty years, the political environment of the Central American countries has not been conducive to promoting investment in small scale rain-fed agriculture. Since the early 90's, there has been a dramatic decrease in support for the small-scale farm sector[19]. The lack of public investment in agriculture has limited agricultural research, as well as training and extension services[20].

However, after two decades of neglecting the agricultural sector and family-based agriculture in Central America, the food price crisis of 2008 and 2011 forced policy makers as well as the international community to reconsider the dominant agricultural and economic models set in place in the early 90's, which mainly focused on production for exports over production for food security[21].

To revitalize rain-fed agriculture in Central America, particularly by small producers, shifts towards agroforestry, silvopastoral systems and conservation agriculture are essential. For both farmers and governments, these seem to be the best options to manage water, soil and climate variability. New policies, programs, investment in human capital, access to financial and extension services for small farmers and recovering traditional practices are all critical.

1.6. Discussion topics to revive rain-fed agriculture in Central America

The main issues under discussion are: (a) renewing general interest in rain-fed agriculture investments; and, (b) promoting better investments based on available knowledge and past experience.

Three questions underlie our discussion:

I. Which practices and technologies have the biggest impacts in improving rain-fed agriculture?
II. Which extension services have been tried in Central America? And, what is their potential to revitalize rain-fed agriculture?
III. What financing mechanisms work best for farming families?

Since mid-2013, the Central American GWI Initiative conducted a series of interviews, reviewed literature and organized a series of events and round tables in El Salvador, Honduras and Nicaragua meant to answer the previous questions.

Stakeholders in each country were involved in the discussion process: local and central government, NGOs, and both the academic and private sectors. The main objective was to examine their experiences with the inter-related topics of extension, financing and agricultural practices in each country.

This task was meant to promote interaction, reflection and joint analysis. A learning alliance was organized in each country, which included all stakeholders. The learning alliances collected information, facilitated discussions and validated information within circulated documents.

Most importantly, the learning alliances were an opportunity for the institutions in charge of implementing extension services, providing financing and promoting new agricultural practices to take on ownership of this multi-stakeholder learning process. It was these institutions that were primarily responsible for collecting

19. IFAD 2011: since the beginning of the 2000s, agricultural budgets barely averaged 2% of the GDP in the region, even though 15%-30% of the economies in these countries depended on agriculture. http://www.ifad.org/hfs/index.htm.
20. IIASTD LAC Report (2009) and Trejos, R., C. Pomareda and J. Villasuso (2004) Policies and Institutions for Agriculture in the XXI century. IICA, Costa Rica.
21. IIASTD LAC Report (2009).

information. A series of dialogue, discussion and joint reflection spaces were opened. Forums and meetings were used for debates and strategic dialogues and complemented by field visits to observe on-the-ground conditions in each country.

2. Introduction and Methodology

Rain-fed agriculture is in the midst of a severe crisis: the impacts of climate variability linked to climate change, rural-urban migration, the instability of food prices, the disappearance of local markets and the decline of public support for the agricultural and livestock sectors, especially for smaller producers, are taking their toll.

When faced with all these challenges, why did GWI decide to start a discussion over the historical and current conditions of agricultural extension services for small producers using rain-fed agriculture to grow their crops? With extension services and technical assistance adapted to their needs, these small producers can better face the impacts of climate variability and find their way out of the ongoing crisis.

In the next chapters we will reflect upon the following critical aspects:

- The challenges of climate variability for rain-fed agriculture, bearing in mind that adaptation can only truly take place at a local level.
- Lessons learned regarding extension and a new perspective on technical assistance, research and innovation.
- The evolution of a new kind of agricultural development focusing mainly on traditional knowledge, and its broad implications.

2.1. What is agricultural extension and its relevance for agriculture as a whole?

The FAO defines extension as "the systems meant to grant farmers, their organizations and other market agents access to know-how, technologies and information; promote their interaction with research partners, education, agroindustry and other relevant institutions; and help in the design of practices and technical management and organization skills". For the FAO, extension is found within relationships and links intended to train and empower producers in skills to be applied within their rural environment, between producers and among a broader set of actors. In 2010, the FAO added the following: "Extension comprises technical knowledge as well as facilitating, brokering and training the different stakeholders to improve how they access the market, while addressing the evolution of different risk factors and protecting the environment".

For its part, the IAASTD[22] report considers that knowledge, science and agricultural technology (KSAT) are the elements which may contribute "to the reduction of hunger and poverty, the improvement of livelihoods in rural areas and the promotion of sustainable development from an environmental, social and economic standpoint". For IAASTD, knowledge is not exclusive to the academic environment (as may be inferred from the original extension model), but rather it's linked to local, traditional and formal knowledge.

22. International Evaluation regarding the role of knowledge, Science and Technology in Agricultural Development, considered as "an intergovernmental process in which thematic, spatial, and temporal aspects will be addressed, and which will include an office made up of different interested parties and will be co-sponsored by the Food and Agriculture Organization of the United Nations (FAO), the Global Environmental Facility (GEF), the United Nations Program for Development (UNDP), the United Nations Environment Programme (UNEP), the United Nations Educational, Scientific and Cultural Organization (UNESCO), the World Bank, and the World Health Organization (WHO)". (IAASTD Latin America and the Caribbean. Document summary: http://www.unep.org/dewa/agassessment/docs/LAC_SDM_220408_Spanish_Final.pdf).

Since its origin, agricultural extension has been based on the idea of broadcasting knowledge, not only in the academic community, but throughout the whole of society. In this regard, the term extension may be said to employ a concept of vertical induction – common within the academic environment - and which in agricultural extension is known as vertical and from above. The underlying theory of change would be that by applying technical and scientific knowledge to agricultural practices, it would help improve both the effectiveness and efficiency of agriculture. In effect, the first manifestations of agricultural extension were focused on transferring technology, or a series of activities oriented toward transmittng technical information, such as the use of different varieties of improved crops or fertilizers. There is now a proposal for technical assistance and support services more focused on agricultural management[23].

Extension services for rain-fed agriculture would seek, in the first place, to increase the productivity of rain water and soils, which in turn would increase productivity of crops and help guarantee national food security. Rain-fed agriculture, mostly implemented by small producers, is fundamental for national food security. The international community now acknowledges that safeguarding national food security and increasing the agricultural revenue of small scale farmers are both key objectives to be achieved during the 21st century. Some recognzie that extension is a key method to achieve both objectives (Swanson, 2010).

To guarantee self-sufficiency and increase the income of farming families, it's necessary to intensify and diversify agricultural systems with agroecological practices and knowledge and market access.. Rain-fed agriculture requires managing water[24] and soil resources. It requires strengthening human, social and natural capital via extension models. Consistent with these ideas, Lester Russell Brown[25] claims that: "A sustainable society is that which is capable of satisfying its own needs without lessening the opportunities of future generations".

Within this context, every extension agent, as facilitator or "knowledge intermediary", is key to connecting agriculture to its surroundings from a holistic point of view . Extension shouldn't only involve the Ministries in charge of planning and executing of extension programs, it should also include Ministries for the Environment and trade unions, among other social actors. In 2010, the FAO proposed that investing in extension is a necessary measure to empower the human and social capital of rural populations, as well as to promote food security and comprehensive rural development. The IAASTD also recognizes that as a result of climate change, a system to impart knowledge, science and agricultural technology – an extension system - becomes necessary to rescue traditional knowledge, agro-ecological knowledge and conventional knowledge. According to the World Bank (2006), investment in science and agricultural technology has been of vital importance to boost farming in the past, and it is more than likely that it will be even more important to achieve future priorities such as the Millenium Development Goals (MDG) to reduce poverty and hunger by half by the year 2015. Extension, development and agricultural investigation systems provided by the public sector, along with capacity building, reduce transaction costs and increase the incentives to invest in sustainable practices. To advance towards sustainable production systems, it becomes necessary to reassign current public and private investments, so as to move from investments with a low "sustainability" performance to others with a higher one (FAO, 2012)[26].

It is recognized that farming, especially small scale farming, is able to fill multiple needs ranging from supplying food and livelihoods to providing environmental and ecological services within a territory. It is therefore important

23. Concepts developed from the work conducted by the OECD. McMahon, Matthew and Alberto Valdez,"Analysis of farm extension ism in Mexico" (Organization for Economic Co-operation and Development, OECD, 2011).
24. In the near future it will not only be necessary to increase investments in agriculture, but rain-fed agriculture will need more attention and specialization. Rockström (2007) claims that to face the food crisis and poverty, new emphasis will be required for small-scale water management in rain-fed agriculture, which will require the reorientation of water policies and large new investments. For example, in vulnerable areas (savannas and slopes), objectives of policies should include: (1) double agricultural productivity of existing water resources; (2) improve the knowledge and implementation of attainable strategies to achieve the maximum potential of land and water productivity; and (3) conduct more research regarding into the possible cascading effects of watersheds-level interventions due to the large-scale adoption of technologies (Rockström, 2009).
25. Brown, Lester Russell, 2003. Business & Economics, 352 pages. Reviews of the hardback edition.
26. The Global State of Agriculture and Food. Invest in agriculture to build a better future.

to determine a link between knowledge-experimentation-innovation-scientific learning and the multiple and diverse forms of local knowledge (IAASTD, 2009:17). These different approaches can't always be found within the farming families themselves, but rather will be found in external actors such as researchers, extension workers or service providers. The way in which these parties interact to produce, experiment and innovate knowledge for small-scale agriculture is key in the development of rain-fed agriculture and its contribution to Central America's food security.

3. Major trends in rural development in Central America

The previous section presented some general concepts regarding agricultural extension. This section explores the evolution of extension per country, and includes a brief review of each of their methodologies and approaches. We hope to provide answers to the following question: Which have been the changes and processes faced by agriculture in Central America? And, what are the significant challenges that have surfaced for agricultural extension?

3.1. Extension within the context of the Green Revolution

In the last 50 years, agriculture in Central America has undergone a series of large transformations as a result of changes in the world economy. The Green Revolution, which brought with it the modernization/enhancement of agriculture, promoted the use of improved seeds and packages made up of chemical inputs such as fertilizers, pesticides and herbicides; as well as the use of irrigation systems, mostly for medium and large producers. It strengthened monoculture farming oriented towards export. Over the years, the experiences and agro-ecological/traditional farming culture of smaller farmers was devalued, poverty was not overcome, and environmental deterioration increased.

During the 60s and the 70s, the INIA[27] model (National Institutes for Agricultural Research) provoked a rapid increase (with respect to human resources and quality) the ability to conduct agricultural research in Latin America. Scientific and technological research developed improved varieties and agrochemical packages (FAO, 1996)[28]. These contributions towards agricultural development were coming from the labs of large transnational corporations and their dissemination required the distribution of this knowledge to producers as final users[29]. The process to disseminate externally-created knowledge and directed to final users represented a one way technology transfer model: from the researcher to the extension agent, and from the latter to the producer. Knowledge held by farming families - how they managed seeds, soil or crops, their traditional farming practices - often inherited from their ancestral culture and transferred from generation to generation, was pushed aside..

In a document published by the IICA (2013)[30], the paradigm of extension created during the Green Revolution is defined as a transmission paradigm[31], and promotes the idea that technicians possess the valid knowledge and that the objective is to convince producers to apply it (a paradigm generally oriented towards the application of inputs) in order to obtain quick answers.

However, this paradigm simplifies the complexity of the problems, as well as the experience and perceptions of the farmers and their families in their own environments. The IICA contends that the model of technological

27. National Institutes for Agricultural Research
28. Report on the World Food Summit
29. Bio-technological research is concentrated principally in the private sector, due to the high investment in laboratories, equipment, specialized human resources, royalty expenses and fexpenses or use of genes and patented processes.
30. Extension strategies: Agricultural families and their adaption to climate change in selected territories of the Southern cone. Strategic guidelines for extension with special emphasis on climate change
31. The used of the diffusion paradigm began in Latin American in 1945, with the difference that in this sub contienent it was not the universities that were the central actor in research, extension and teaching (as occurred I the US in the Land Grant College model).

supply from the technician to the farmer in a vertical fashion increases the gap between what the producers want and what the research and development agencies offer. For example, the relationship between soil-water-plant-production system or person-family-territory has been little studied in the region, all characteristics of rainfed agriculture based on farming practices in indigenous systems.

The logic behind the transmission paradigm is the massive adoption of technology through a vertical relationship: knowledge that marginalizes traditional customs, and which derives from research centers, frequently without any feedback from the territory or the people who work it (IICA, 2013). In the transmission model, applying this research generally included collateral investments in physical infrastructure such as roads or irrigation systems (IAASTD, 2009, Vol. III:218).

By prioritizing extension services to transfer scientific knowledge, attention tended to focus solely on productivity and neglected how productivity affected the rest of the production system, such as the unsustainable use of soil, water and forests. It ushered in the era of monoculture, with crops such as cotton, banana or sugar cane, all of which are associated with water pollution and soil degradation. This extension model tends to weaken the ability for self-learning and innovation in the rural communities, while also provoking the undervaluing and loss of knowledge and traditional practices which are then pushed aside by technical proposals, such as the selection and preservation of seeds by women.

At some specific times, national research systems received strong financial support from their local governments and foreign donors in order to set in motion agricultural modernization[32]. For the most part, national research and technology transfer systems were conceived as centralized programs, to "supply" a demand. Their basic goals were to solve technological issues at the plant level and promote the adoption of new available technologies. The post-crop period and agro-industrialization were not perceived as high priority issues and when attention was paid to them, it was provided via separate organizational structures (IICA, 2012).

3.2. Extension before the New Green Revolution (Biotechnologies – Genetic Modification)

With the birth of biotechnology, promoted by the transnational corporations as well as by some extension agencies, we speak of a new green revolution whose main tools are genetically modified seeds (transgenics). Due to the high cost of these seeds (as well as that of the inputs that accompany them), small farmers are generally excluded from these advances, which at the same time increases the risks of losing and/or polluting the genetic diversity of the Central American region.

Genetically modified seeds began their commercial expansion in 1996 [33], thus widening the gap between the knowledge and learning available to small farmers. This knowledge originates outside the agro-ecological environment (large laboratories from transnational corporations). Improvements in agricultural production, exports and revenue accumulate mainly to large producers. With time, the environmental cost can become very high. Intensive use of fertilizers and pesticides in our soils could well be one of the main causes of the decrease in crop yield as well as the reduction in the levels of micro-nutrients in food (IAASTD 2009, Vol. III).

32. The creation of the CGIAR centers in 1960 set the ground for Green Revolution technologies. Several high yielding varieties of rice, wheat and corn were developed. And by the year 2000, there were already 8,000 modern varieties being produced by over 400 public improvement programs in more than 100 countries.

33. Global expansion of commercial transgenic crops such as corn, soy and canola began in 1996. The species that are currently being planted for commercial purposes are: soy, corn, cotton, rapeseed, pumpkin, potato, papaya, alfalfa, beet, tomato and bell pepper (James, 2009).

The development of agricultural biotechnology will continue to grow, promoted by the large transnational corporations and growing markets, as well as the demand for access to more and better food products[34]. The new advances in molecular biology offer opportunities for research and a solution to the problems affecting developing countries, such as worsening water shortages. The development of drought tolerant crops would also be of great value, as well as any genetic improvements to develop a tolerance or resistance to plagues and disease. However, specialized studies to evaluate the impact on small scale farming in Central America are required, as well as on the consumption side, studies to determine the security and safety of the food being consumed.

In Central America, the use of genetically modified seeds for production purposes is only commercially available in Honduras and Costa Rica. To date, Honduras has approximately 100,000 hectares planted with transgenic corn. In Nicaragua, the Seeds and Agro-biotechnology Program of the Nicaraguan Institute of Farming Technologies (INTA) was founded in 2007 and is educating ten young people in biotechnology at the University of Finland. In El Salvador, a researcher from the National Center for Farming and ForestryTechnology (CENTA) conducted a series of agronomic tests with transgenic materials from corn. In Honduras, Zamorano University began working with Monsanto to coordinate the distribution and development of transgenic seeds to sell and export. However, the results of a study conducted by Zamorano (Ramírez, J., 2008)[35] show that the lack of technical assistance from the companies trading these seeds was a negative factor, hurting the farmer's learning process – the users of transgenic hybrids[36].

Central America countries not only have to address the impact of transgenic seeds on their crop yield, but also the consequences for food security and poverty reduction. The main goal, therefore is to help farmers regain control over their crops, their inputs and their livelihoods[37]. For example, the countries in the region must study how free trade agreements, especially CAFTA-DR, may have a negative impact on national research and the development of local seeds[38]. Advocates of biotechnology argue that the only way to increase yields is by using transgenic crops, which is why they regard these innovations as "the new green revolution".

Others have questioned whether biotechnology is really the answer to solving food security, mainly because for crops to grow, they require inputs which increase the degradation of soil, water resources, and the environment generally. In this sense, it would seem more viable to increase productivity through the restoration of soils, increasing the biomass and the diversification of the agricultural system (crops, plants, trees). The nature of the scientific and technical expertise for small producers to implement the bio-technological proposal as opposed to the agro-ecological proposal, allowing them to understand the risks they face, is significantly different. However, the Central American countries have not conducted a thorough or conclusive study about the economic, environmental and social consequences that transgenic seeds are likely to have on rain-fed agriculture practices.

34. Genetically modified seeds were designed to be resistant to herbicides or to incorporate the biological agent Bt (Bacillusthuringiensis) which is a common ground bacteria that when introduced in the plant produces a protein which can be toxic to certain insects.
35. The experiment took place between February and July of 2002 at the Zamorano University in Honduras, where a study was conducted to evaluated damage caused by plagues (bollworms, fruit worms and stem borer worms) in plants. During the course of the experiment data was checked for 20 transgenic hybrids with Bt and 20 without Bt.
36. The number of applications far exceeded those recommended, and this was owed to the lack of technical assistance provided by the business in charge of selling the seed; and due to the lack of extension programs.
37. Furthermore, the signatory countries of the Cartagena Protocol on Security of the Biotechnology Convention on Biological Diversity must comply with the objective of ensuring the handling of transportation and use of live modified organisms resulting from modern biotechnology and which may have adverse effects on the biological diversity. At the same time, they must also take into account all possible risks for human health. This was adopted on January 29 of 2000 and became effective as of September 11th of 2003 (IAASTD, 2009: 168).
38. For example, the controversy raised by U.S. foreign policies which tried to impose rules regarding seeds through CAFTA-DR, and which would have had a negative impact on the development of the Family Agriculture Program, especially for small seed producers.

3.3. Structural adjustment

By the end of the 1980's and continuing into the following decade, a series of structural adjustment programs were executed, which resulted in the dismantlement of the national agricultural support systems and the privatization of resources and services. During the 90's, national agricultural extension services were partly replaced by decentralized consulting services managed by NGOs, local governments, companies which distributed chemical products as well as by producer associations (World Bank, 2006:17). Lending companies also became an important source of information and guidance for farmers, which caused neglect and decapitalization of small farm operations.

With the above-mentioned structural adjustment, the relationship among knowledge – experimentation – learning faced its biggest challenge yet. One of the premises for the adjustment programs was that reducing the role of the public sector in extension would promote a larger participation of the private sector . And this change would generate a balance, removing from the market all inefficient producers. (Rivera, R., s.f.)[39]. During this period, the first efforts were launched to develop public-private partnerships to create and transfer technologies. But in spite of these aspirations, the dismantlement of government agencies led to the participation of very few private service providers. Small farmers then turned for help to producer associations and NGO's[40] dedicated to fighting poverty in the farming sector and compensating for the lack of public services and private alternatives (World Bank, 2008:151)[41]. It also resulted in the creation of a series of social assistance programs which provided cash allowances (often subject to conditions) for the more vulnerable sectors (World Bank, 2008: 226).

During the 1990's a series of changes took place in contracting and other forms of privatization in research, extension and assistance services. In many countries, these models are still in effect. In this process, the State, which had been dismantled during the 90s, continues to steadily lose a large part of their abilities to produce technology and organize learning processes. Additionally, the IAASTD study reported the lack of participation of producers due to solid organizations. In this way, privatization contributed to the deterioration of the public interest, equity and sustainability.

Below are some of the changes that occurred within extension programs due to the structural adjustments which took place in Nicaragua, El Salvador and Honduras.

NICARAGUA

Nicaragua implemented an extension service outsourcing system, paid for by the government and provided by the private sector. One of the main results of this was the creation of a market for private extension services. The responsibility to provide extension services and conduct research (until then held by the Ministry of Agriculture) was transferred to INTA in 1993. Efforts were focused on creating a model for the generation and transfer of technology, guided by the technological demand within a public-private context. This framework was implemented within National Systems for Agricultural Research. In 2000, a grant fund was established (FUNICA) to finance technical assistance projects.

39. Rivera, René. Transparency and deregulation in Central America: Impacts in Salvadoran Family Agriculture. Fundación Nacional para el Desarrollo (FUNDE). University of El Salvador researcher http://ase.tufts.edu/gdae/Pubs/rp/wg/AgricultureBook_Span/PromesasPeligrosCh7Rivera.pdf

40. An interesting impact is that the NGOs explored new ways to conduct research and extension services which included different ways farmers and their associations could participate in the different phases of the research process, as well as as in the evaluation and dissemination of the results.

41. Wold Development Report 2008: Agriculture for Development.

The extension system used as its axis a group of leading producers, "Agricultural Representatives", organized in agricultural circles. The methodologies used by INTA were: massive technical assistance (ATPM) which was 100% public; co-financed public technical assistance (ATP1), financed by outside resources and producers; and, public-private technical assistance (ATP2), which was comprised of 60% public funds and 40% producers funds. Between 2003 and 2004 these modalities were adapted to watershed management and the ATP2 was reduced to 50%[42].

The biggest impact on the sector was the closure of the National Development Bank (Banco Nacional de Desarrollo) and other public agencies in charge of providing financial support for the sector, which left many small farmers without access to financing. Between 1990 and 1998, the Agroindustrial and Forestry Ministry lost 688 workers (Nitlaplan, s.f.). The small farmers that had managed to keep their land found themselves faced with a series of difficulties to access credit, technical assistance and inputs. Given the the focus on generating products for export, the promotion of complex irrigation systems and the overall weakening of resources, the ability of small farmers to generate food and income deteriorated (Bean, 2008)[43]. This situation caused the abandonment of agriculture, a large out-migration and the reconcentration of land in the hands of arge producers or corporations, reversing a process of agrarian reform process from the decade of the 1980s.

EL SALVADOR

El Salvador dismantled the General Directorate for Rural Development of its Ministry of Agriculture. All extension duties were transferred in 1993 to the National Centre of Agricultural and Forestry Technology (CENTA) and a private technical assistance system was developed. Public investment to support the farming sector was cut to 1.2% (2005), when between 1995 and 2000 it had been increased from 1.7% to 8%. This reduction affected the agencies advancing technical assistance, technological innovation and research.

The most important Salvadoran agricultural agencies were privatized; all of them linked until then to the country's strongest sectors: coffee and sugar (INCAFÉ[44] , INAZUCAR[45] , PROCAFÉ [46] , PROCAFÉ [47]). Others too were shut down, such as IRA [48], and the Banco de Tierras (Land Bank), which in turn resulted in a legal vacuum (Rivera, R. s.f.). 70% of pending land cases remain to date without any type of ruling or resolution.

As for technical assistance, CENTA reduced the number of agencies from 75 in 1993 to 60 by the year 2000. A new extension model with specific targets (EDO) was implemented, guided by a strategy focused on transferring knowledge through personalized visits, providing training for producers organized within their communities and follow up on specific objectives determined jointly with the communities.

42. With the establishment of the Sistema Nacional de Innovación Tecnológica/COSINTA (National System for Technological Innovation), and the participation of NGOs, universities and private sector, the Fundación para el Desarrollo Tecnológico Agropecuario y Forestal de Nicaragua/FUNICA (Foundation for the Agroindustrial and Forestry Technological Development) was created to search for consensus and coordination between all stakeholders. To date, FUNICA still works successfully.
43. Structural adjustments in Nicaragua: Impacts on agricultural workers.
44. National agency responsible for coffee production and marketing policies.
45. Institución creada en 1980 para administrar la exportación y comercialización del azúcar y mieles.
46. IInstitution financed by coffee producers at service to the sector.
47. Created in 1950 to regulate the supply and sale of all agricultural production.
48. DICTA, FHIA, FAO, IHCAFE, PASOLAC. 2005. Simposium on Agricultural Extension in Honduras: Background, current situation and perspectives.

HONDURAS

Honduras began its adjustment process in 1982, which included a fiscal deficit reduction, restrictions on public spending and freezing local wages. By the end of 1991, the Honduran Government issued a Law for the Development and Modernization of the Agricultural Sector, which encompassed a series of rural reforms that substantially modified rural institutions and agricultural policies. The Directorate of Agricultural Science and Technologies (DICTA) was created and oriented towards increasing farmer competitiveness and providing private technical assistance services financed jointly by the Government and the producers. However, under this system many small producers, several of them working in hillsides, had no access to extension services. [49]

The Department of Agricultural Extension (DEA) was dismantled and replaced by a grant fund for science and technology organized by PRONADERS[50] The privatization of technical assistance services and the existence of NGOs providing agricultural extension services added to the already debilitated role of local farming education centers and brought about the low coverage and high cost of extension services in Honduras, its limited relation with research and educational centers and an overall lack of connection with markets. This disintegration of the public research and extension systems persists to this day.

Table 1: Changes in agricultural extension services in El Salvador, Nicaragua and Honduras during the 1990s

COUNTRY	INSTITUTION BEFORE 1990	NEW INSTITUTION	ORIENTATION	DECENTRALIZATION	OUTSOURCING	CO-FINANCING
EL SALVADOR	MAG: General Directorate of Rural Development	CENTA (research and extension): (1) agricultural and forestry extension; (2) technical assistance to agricultural groups; and (3) training and certification programs	Technology Transfer Projects created by farmer associations and supervised by CENTA.	Decentralized network of extension and training offices.	Yes, in some cases	In some cases for technical assistance projects.
HONDURAS	MAG: Department of Agricultural Extension (DEA)	DEA was dismantled: PRONADERS / PROAGRO	Branches assistance: small producers / commercial producers.	No	Yes	Yes
NICARAGUA	MAG: Directorate of Agricultural Extension	INTA / FUNICA	Branches assistance: ATPM / ATP1/ ATP2 Market incentives are used (meaning, co-financing) to fine tune extensionists' attention towards farmers' needs.	INTA divided the country into five regions	In part	Yes, with a progressive reduction of public contributions

Source:

World Bank 2006: Institutional innovation in agricultural research and extension systems in Latin America and the Caribbean.

49. National Program for Sustainable Rural Development
50. National Program for Food and Agricultural Development

4. Current challenges for Rain-fed Agriculture in Central Americ

The price crisis and impacts of climate change are currently the most acute structural challenges facing a renewed rain-fed agriculture that can guarantee food security. However, these very challenges also present an opportunity for rain-fed agriculture, and may translate into smart investments on the part of producers and governments. There could be, for example, investments in soil restoration practices that allow a larger infiltration of rainwater into soil; water planting and harvesting; and, agro-forestry systems which generate revenue amongst producers; among others.

4.1. The food price crisis[51]

The food price crisis in 2008 and 2011 caused a serious predicament and social instability in some countries; the knowledge-experimentation-learning systems were faced once again with a new challenge. The crisis placed in debate the urgency of reviving small-scale farming, mostly rain-fed farming, given its important contribution to food security for the countries of the region.

In Central America, between January of 2007 and April of 2008, the average price of white corn increased by 20.5%, and the price of red beans by 80.7% (PMA 2008). Given that food absorbs the majority of the family income for both vulnerable urban and rural populations, the food price increase put a high percentage of the Central American population at risk of poverty and food insecurity. The region was already importing up to 40% of their foodstuffs, a condition which makes them highly vulnerable to any changes in international market prices (IICA 2011).

Dependence on subsidized and imported food products disarticulated local production systems. The main victims were small local farmers. Families whose main source of income was farming faced decreasing purchasing power and access to food[52], whether produced locally or imported (IAASTD, 2009, Vol. III). The rising food price crisis caused riots in more than 20 countries. Editorialists worldwide wrote about the end of cheap food.

51. From the 1970s until to the early 2000s, prices of food in the international markets remained relatively stable. Between 2006 and 2008, international prices for basic food products suddenly increased 60%, while cereal prices doubled. By mid 2008, the price of food in the international markets had reached its highest point in nearly 30 years. And in January 2011, the prices of food skyrocketed once again for the second time in only four years.

52. In El Salvador in 2007, the WFP estimated the number of people living in extreme poverty at approximately 6.5% (92,000 poeple) and there appeared 104,000 newly-poor as a consequence of the increases in the price of food. The World Bank estimated that from 2005 to 2007, the number of poor in Nicaragua may have risen by 10.5% and 4.2%, in urban and rual areas respectively as a result of the higher price of basic food goods (WFP, 2008).

Figure 2:

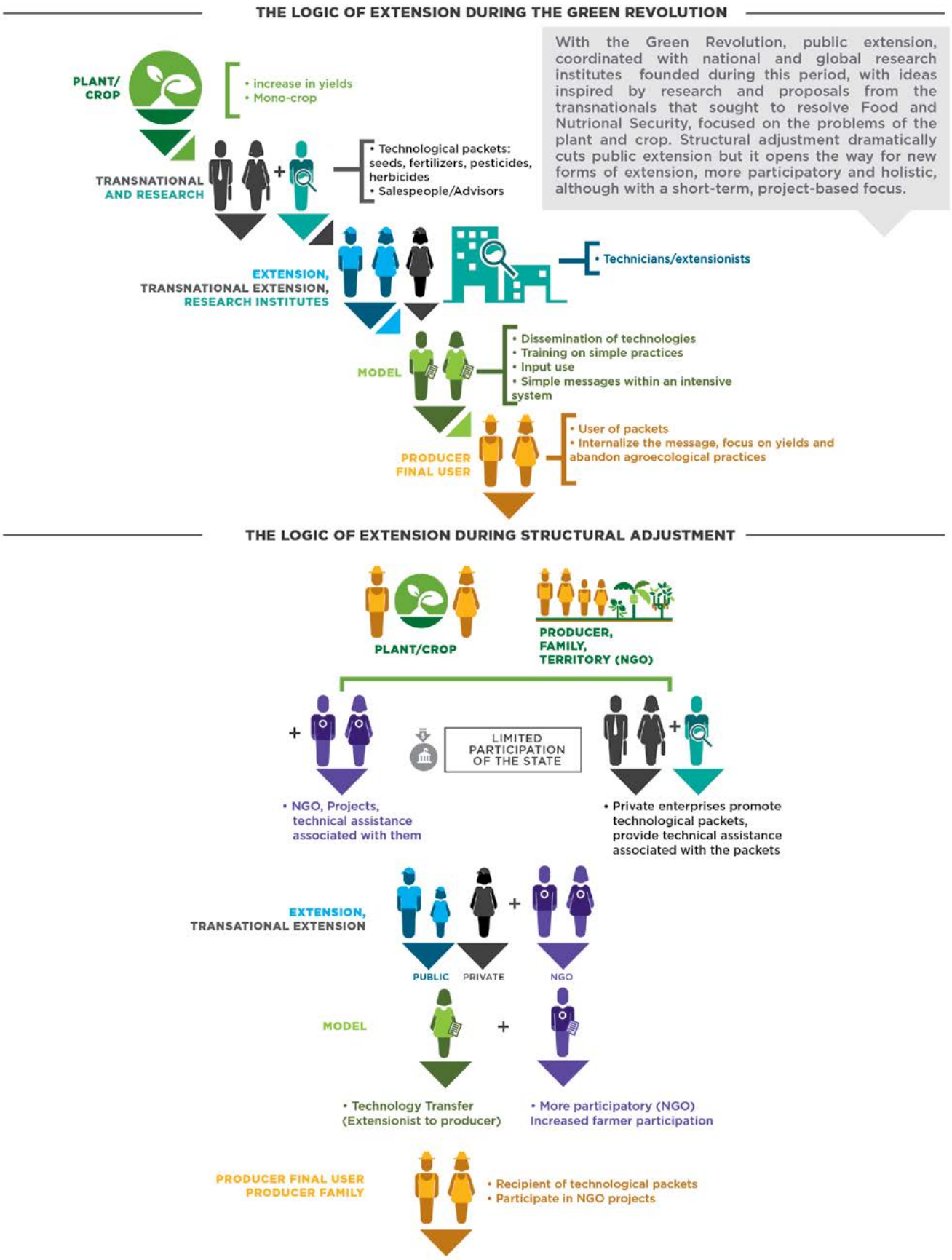

THE LOGIC OF EXTENSION DURING THE GREEN REVOLUTION
With the Green Revolution, public extension, coordinated with national and global research institutes founded during this period, with ideas inspired by research and proposals from the transnationals that sought to resolve Food and Nutrional Security, focused on the problems of the plant and crop. Structural adjustment dramatically cuts public extension but it opens the way for new forms of extension, more participatory and holistic, although with a short-term, project-based focus.
PLANT/ CROP
• increase in yields
• Mono-crop
TRANSNATIONAL AND RESEARCH
• Technological packets: seeds, fertilizers, pesticides, herbicides
• Salespeople/Advisors
EXTENSION, TRANSNATIONAL EXTENSION, RESEARCH INSTITUTES
• Technicians/extensionists
MODEL
• Dissemination of technologies
• Training on simple practices
• Input use
• Simple messages within an intensive system
PRODUCER FINAL USER
• User of packets
• Internalize the message, focus on yields and abandon agroecological practices
THE LOGIC OF EXTENSION DURING STRUCTURAL ADJUSTMENT
PLANT/CROP
PRODUCER, FAMILY, TERRITORY (NGO)
LIMITED PARTICIPATION OF THE STATE
• NGO, Projects, technical assistance associated with them
• Private enterprises promote technological packets, provide technical assistance associated with the packets
EXTENSION, TRANSATIONAL EXTENSION
PUBLIC
PRIVATE
NGO
MODEL
• Technology Transfer (Extensionist to producer)
• More participatory (NGO) Increased farmer participation
PRODUCER FINAL USER PRODUCER FAMILY
• Recipient of technological packets
• Participate in NGO projects

Figure 3: Food Price index as reported by FAO 1990-2011

Small farmers faced higher costs for inputs (oil and fertilizers), less access to credit, an increase in extreme climate events and a limited extension system with respect to coverage and objectives. Under these conditions their vulnerability increased, and the sale of productive assets such as land and cattle was encouraged, causing even greater decapitalization. When price are unpredictable, the probability of small farmers investing in the increase of productivity is less likely (FAO, 2011). This is a hot topic within the sector, given that by the third quarter of 2014 the volatility of food prices continued to rise, fueled by the droughts caused by the El Niño phenomenon.

Extension systems found themselves overwhelmed by the demands of producers requesting information and short and long term solutions. In the run up to food price crisis there were several international-level structural aspects such as the demand for grains to produce bio-fuels, the increase of food demand in emerging markets and extended drought periods as a result of climate change.

The FAO (2011) recommends that to prevent price volatility over the long term, countries must increase productivity, sustainability and their agriculture's ability to adapt. To achieve this, three types of investment are necessary: (1) direct investment in research and development to increase productivity and promote the resilient agricultural systems; (2) investments focused on strengthening the bond between the primary farming sector and extension services; and, (3) investments to improve human welfare.

Ideally, extension services should provide or establish a link between data and the existing knowledge about market prices, including regulatory structures, quality standards and consumer demands; as well as access to financial services so that farmers are able to successfully address change within a context of risk (Christoplos, 2010)[53]. National systems which had only just begun a restructuring process have not had the chance to put into practice their ability for quick recovery.

53. FAO. 2010. How to move the potential for agricultural and rural extension.

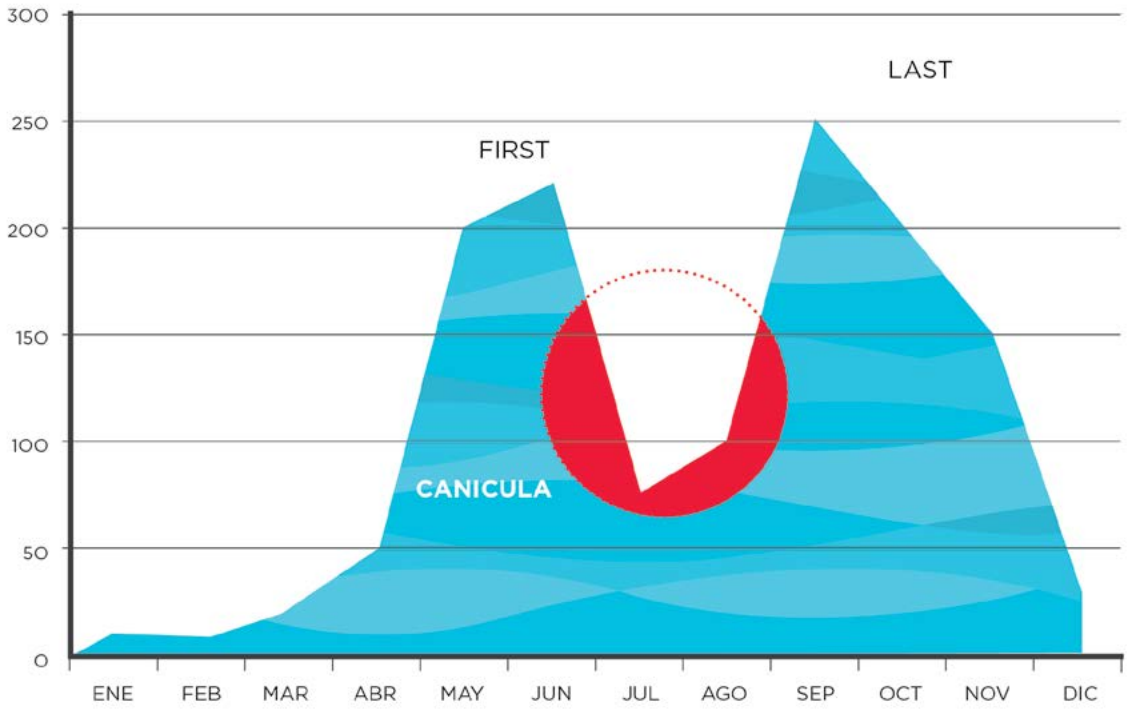
4.2. Climate variability and the effects of climate change

At present, agriculture faces a new challenge. Are extension systems prepared to deal with climate variability and the effects of climate change?

Rockström (2007)[54] points out that the biggest challenge in semi-arid and dry sub-humid regions is the extreme variability of rainfall, characterized either by few rain events, high intensity storms or a high frequency of extended dry seasons and floods[55]. According to the research, it is important to understand the correlation between hunger, poverty and water, given the fact that hydro-climatic conditions and water management affect yields in rain-fed agriculture systems. This requires that farmers to have the capacity to analyze newly available information, with the support of a renewed extension program.

Rainfall in Central America usually averages 1,500mm, and virtually every country in the region receives at least 1,000mm. Hence, there is a great amount of rainfall in the area but only during the rainy season, which lasts for approximately six months, followed by a very marked dry season. Although the Central American countries have high volumes of rainfall, the use of farming and husbandry practices that have degraded the environment have caused a serious loss of soil and water. This affects crop yields and creates greater vulnerability to price volatility and climate change.

Figure 4: Typical rainfall pattern in Central America (mm)



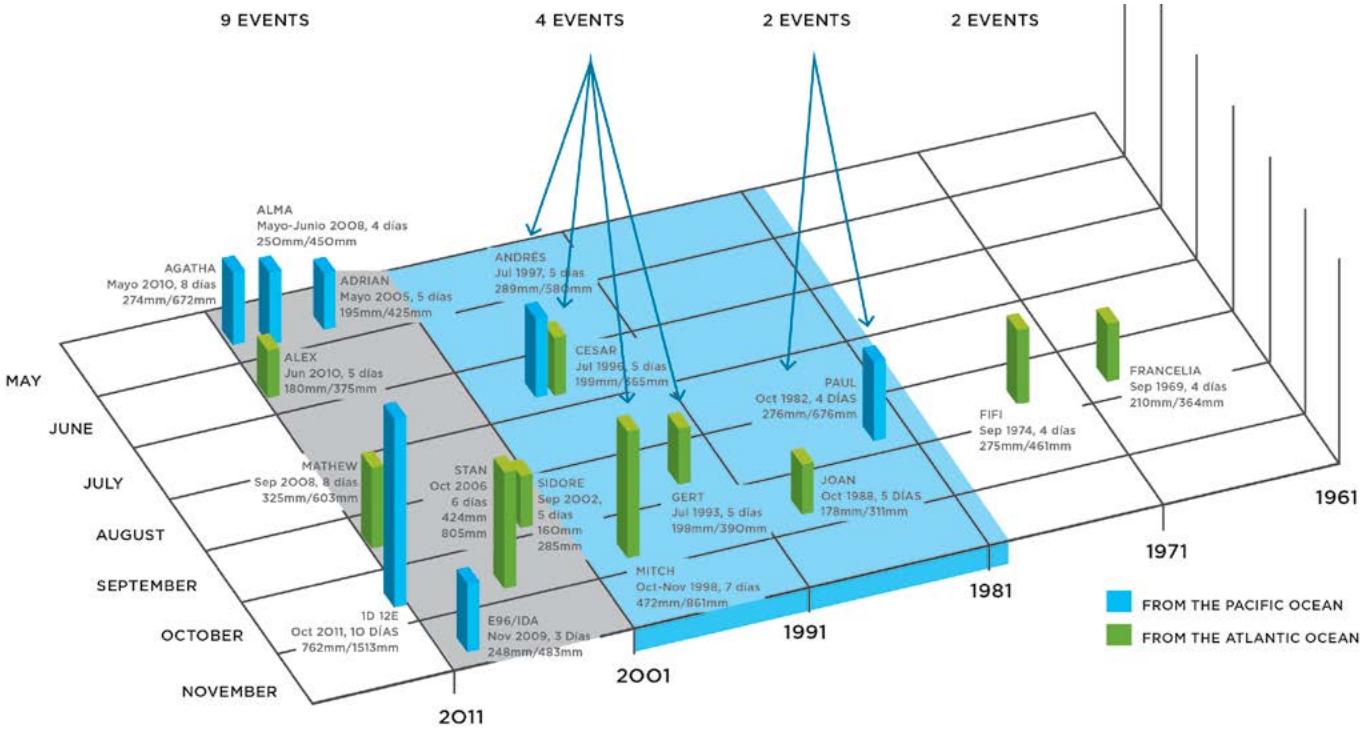
Source: Paul Hicks, based on data provided by the Ministry of the Environment in 2009.

54. IWMI, Part 4, Chapters 8-16. Managing water in rain fed agriculture.
55. Variability of rainfall produces short periods of water stress during critical growth stages (canícula) on almost every rainy season (Barron and others, 2003).

The graph explains rainfall patterns in Central America and highlights a powerful and well-known phenomenon: the "canicula" (summer heatwave). The importance of this phenomenon lies in its timing and severity given that it's a critical climate risk factor for farmers. It happens during the rainy season and shapes farmers' decisions concerning crops.

In the introduction we saw an illustration provided by the Salvadoran government showing a new trend, also relevant to the rest of Central America, depicting extreme events originating in the Pacific Ocean and which increase the region's vulnerability.

Figure 5: Tropical cyclones and low pressure systems which have caused torrential rains in El Salvador. 1961-2011



Source: National Program for the Restoration of Ecosystems and Landscapes (PREP), 2012.

According to Simpson and Burpee (2014), the future of agriculture in the "new normal" is defined by increased risks and uncertainties related to climate change. For extension systems to be able to efficiently respond to climate change risks, it's important to understand the specific problems being faced by producers within their territories. The challenge is to help famers and rural communities transition from their current conditions to those they are likely to face in the future.

In this sense, extension and support services should: (1) identify risks which may be relevant to climate change, geographical catchment areas and likely startup trajectories; (2) evaluate vulnerability and resilience of affected human populations and natural resources; and, (3) implement suitable actions according to corresponding scales and areas. The series of actions represents an enormous challenge for already weakened agencies. Adequate territorial planning and inter-institutional implementation is a must; given that the challenge demands a comprehensive focus to help communities develop resilience.

5. Public systems and the approach to food security and poverty

Extreme pressures and risks regarding food security and social stability from price volatility and climate change have forced each government to review, and in some cases, rethink existing institutional frameworks. The major challenge lies in calibrating national and regional farming sector institutions into personnel capacities, infrastructure and essential tools so they may successfully implement plans and programs to guarantee food security.

The challenge is strengthening national capacities and those of the many small farmer whose contributions are basic to guarantee food security for thousands of families. They are trapped within production and marketing systems that devalue their knowledge and don't allow them to overcome the poverty they live in. To deal successfully with price volatility while supporting the population, regional governments have decided to liberalize wheat flour import quotas free of tariffs, continue generalized subsidies, distribute agricultural input packages to small producers and, in some cases, restrict corn and/or red bean exports. More attention has been given to food assistance strategies, in many cases related to school snack programs or conditional monetary allowance programs. But in general terms, the sustainability of these measures is not guaranteed (PMA 2008).

Improving the well-being of small producers in rural areas is an enormous challenge for governments, and places pressure on public research and extension agencies (World Bank, 2006:21)[56]. Presented below is a brief overview of extension efforts to guarantee food security made by the three countries.

5.1. Nicaragua

The evolution of Nicaragua's efforts may be divided into two stages. Until 2006, food security, at a national level, was a low priority. It wasn't until 2007 that it started to be considered a high priority issue. The producer and his family then became the policy focus. As a result of this, efforts were made to strengthen PRORURAL's sectoral strategy which includes three sub-programs: the National Food Program, the Rural Agro-industry Program and the Forestry Program. PRORURAL-I is part of the main framework of national policies known as the National Human Development Plan, 2007-2016.

The Nicaraguan government was able to align international cooperation with this strategy. The Agriculture, Livestock and Forestry Ministry implemented a series of social assistance programs whose main purpose was to distribute funds amongst the more vulnerable small farmers, especially women heads of households. Support occurs through the direct delivery of a package of goods or livestock assets (an agricultural production package known as Zero Hunger) and includes cows, pigs and barnyard poultry and equipment. It also includes a technical assistance component for the women receiving the aid.

In 2012, the Ministry of Family, Community, Cooperative and Associative Economy (MEFCCA) was created to assist family agriculture directly, including micro, small and medium family enterprises. This Ministry seeks to improve yields, value-added processes, revenues and living conditions of small farmers and their families.57I In 2014, the MEFCCA took on extension functions transferred from INTA. These extension services focus on research and innovation to respond to current-day challenges.

56. In this context, a common concern has been to increase production yields of the main crops to feed a growing population and generate a surplus to improve farmers's revenues and international trade. However, while prices have risen for agricultural products, so has the cost of the land, chemical inputs and energy, hence making technological innovation necessary to improve quality and productivity (Pomareda, 2005, quoted by ASTI, 2008).

57. These produce 60% of coffee 65% of the meat and 80% of the basic grains (beans, corn, sesame and sorghum), 90% of fruits and vegetables (fruta, citrus, vegetables and others), 90% of the honey, generate 56% of agricultural exports and represent about 80% of the economically active farming population.

Through various programs – Zero Hunger, the National Seeds Program, Fund for Rural Credit and Food and Nutritional Security – the national government (2007-2012) seeks to improve the productive capacity of small farmers with land access (70% of rural homes have a land parcel for agricutural use)58 Currently, Nicaragua is developing a new extension model for family farming support programs. This new model will include experiences of both public and private entities. For example, the combination of farmer field schools and rural promotion is currently being tested to increase the efficiency and coverage of extension services (Preissing 2011)59. This new model seeks to provide the best extension practices for research which include: natural resources management, alliances and capacity building. These can be classified in: (1) development of technology markets, (2) assistance to grass-roots-level organizations in rural areas, and, (3) greater coordination between rural promoters and field schools.

Up until the first months of 2014, INTA had three kinds of free extension programs: i) An Integrated Crop Management Program with emphasis on climate change (sustainable agriculture, post-crop and market development) ii) The Seed and Bio-technologies Program (seed production and agro bio-technology) and, iii) A Livestock Program (cattle and small livestock, pastures). The structure for technology transfer is made up of 21 agencies, five regional delegations, five centers for technological development (CDT in Spanish), three experimental stations and two labs. With INTA's new focus in research and technological transfer intended for technicians and extension promoters, the government hopes to improve small producers' capacity to adapt. And by transferring extension into the hands of the Family Economy Ministry, the government seeks to strengthen support to small producers. Furthermore, the above-mentioned Ministry is responsible for providing direct attention to this sub-sector. However, the institutional division that currently exists between research and extension services requires greater institutional integration.

During the 2005-2006 period, private and public-private extension services were gradually consolidated under the outlines explained in the section on structural adjustment. And although a series of methodologies with public and private arrangements were implemented, this didn't result in greater inclusion or service coverage for producers.

5.2. El Salvador

In El Salvador, remittances mainly originate from rural families leaving the countryside to migrate to the United States. The out-migration reduces the number of able producers (age, education, roots) that can face the challenges of sustainable production and guarantee food security. At the same time, due to the reduced investment in agriculture, there is an unsatisfied food demand in the country (by those who receive the aforementioned remittances).

Currently, the country's economy depends much more on both the services and commercial sectors, and is highly dependent on imports. From 1980 onwards, farming exports began to lose their importance, as higher focus was instead placed on family remittances. By 1992-1994, remittances represented over 100% of exports (Guillén, 2012) [60].

58. The sustainability of these actions is not assured but in 2013, the Global Fund to Support Food Security (GAFSP) approved $31 millionto the government of Nicaragua's proposal for "PRORURAL – Support for increase in productivity and food security and nutrition on Nicaragua's Caribbean coast."

59. Preissing, John. 2011. Good Practices in Extension Management for Central America. Innovations in Extension and Advisory Services.International Conference.Nairobi, Kenia: CTA. http://www.slideshare.net/ctaspace/good-practices-inextensionmanagementforcentralamerica.

60. Analysis of the downfall of agriculture in El Salvador beginning with the economic liberalization process in the 90s. Universidad Centroamericana José Simeón Cañas.

The high inflow of remittances into the country exerted a strong pressure on national currency, eventually causing the colon's appreciation. This is the reason that in 1993, the Central Bank had to step in and establish a fixed price on the exchange rate. Later on, the decision was made to dollarize the economy. All these measures caused a real appreciation of the exchange rate, penalizing the farming sector that exports products (IICA, 2005).

The impact on the farming sector has been a serious one. Agriculture went from representing 19% of the GDP in 1980, to 13.% in 1997 and 12% in 2012. How did things get to this point? It's known as the "Dutch Disease" [61], which increases the prices on export goods and lowers them on imports. Domestic tradeable goods sectors such as agriculture and industry then become depressed, because their production costs skyrocket and they lose their competitive margin in the international market. At the other end, sectors producing non-tradeable goods, such as financial services or other similar services, tend to be favored, as well as those linked to the trade of imported products (CEPAL, s.f.)[62].

In 2006, IDB and IMF experts warned that El Salvador's economic policy needed to focus on generating a production capacity capable of meeting the demand generated by remittances, foreseeing that these at some point will cease, as has been the case in other countries. If there is no additional production capacity, a strong recession may very well be on the horizon fueled by a dollarized economy and which may include the collapse of the banking system and severe social conflict (Cáceres, 2006).[63]

In this context, the Family Agriculture-Food Security Program 2011-2014 got its start, acting at two simultaneous levels. PAF's central focus is family. It was conceived to contribute to the empowerment of rural communities and facilitate processes to help them manage their integrated development. The objective of PAF's Food Security program is for participating families to develop improved production systems and adopt good practices in Food and Nutritional Security (SAN) that increase food availability, access, biological use[64] and consumption.

The part of the program oriented towards strengthening government institutions responsible for technical assistance, such as CENTA, presents a great opportunity to boost the knowledge-learning framework through which farming families may become involved in the generation of knowledge. Horizontal teaching methodologies are being used such as the Pilot Family/FD which bases itself on the leadership role played by families within their communities. Likewise, Field Schools or Home Workshops are all inclusive teaching-learning methods that empower families as knowledge management units needed to promote change within their territories.

Other agencies providing extension services are: Fomilenio[65], which is a semi-autonomous government development program implementing a project with several components in northern El Salvador; the Faculty of Agriculture at the Universidad de El Salvador which keeps a full-time staff of five working on extension; NGOs such as World Vision, which in 2009 employed 23 extension workers; and the Corporation of Exporters (COEXPORT) in charge of managing the AgroCAFTA Program that provides technical assistance to commercial farmers. The project "Support to small-scale farmers in the Eastern Region" funded by the Japanese International Cooperation Agency (JICA) promotes a community extension system to complement CENTA's extension services for the environment and focuses on production (JICA 2011).

61. A macroeconomic effect that works against a sector that stems from what is known as the "Dutch disease". This situation happens when there is a massive in-flow of dollars into a country, thus provoking the real appreciation of local currency, making export goods more expensive and lowering the price of import products.
62. Lazo, José Francisco. CEPAL. http://www.eclac.org/publicaciones/xml/8/4648/SALVADOR.pdf
63. Cáceres, Luis and Nolvia Saca. Officials at the Inter-American Development Bank and the International Monetary Fund, respectively. Mechanisms to transfer the effects of remittances in El Salvador. Foreign Trade. October 2006.
64. Biological use is a food preparation method to help take better advantage of its nutrients
65. Financed by the Millennium Challenge Corporation, and its a five year agreement.


USA

5.3. Honduras

Food security is one of the highest priorities for the Honduran Government. Four inter-related strategies address food insecurity and have established goals to reduce poverty. There are two major plans at a national level: Country Vision and the National Development Plan; and two implementation plans: the National Food Security and Nutrition Strategy (ENSAN) and the Country Investments Plan (PIPSA).

Honduras is the only of the three countries discussed here that has a long term development plan "Country Vision 2010-2038", where two out of the four objectives relate to the eradication of poverty. The National Development Plan (National Plan 2010-2022) is based on objectives defined by Country Vision (eradicate extreme poverty, reduce the number of homes living in poverty to 15%, irrigate 400,000 hectares and improve Honduras' global competitiveness). ENSAN is a roadmap to improve food and nutritional security; it addresses food availability for the poor living under extreme conditions and includes a series of investments in nutrition (GAFSP proposal, 2013)[66]. These plans also provide a guideline for farming extension services.

PIPSA provides a plan for market-oriented agro-industry that favors the poor. PIPSA's main goal is to reduce poverty and extreme poverty by 10% during 2014. Results show that agricultural exports and the number of producers adopting the new technologies (for example, drip irrigation) have surpassed the four year target. The goals set for rural roads have almost been reached, but infrastructure efforts have not yet focused on food insecurity.

The Honduran extension system is multi-faceted, and seems to be heading toward rural advisory services (IFPRI, 2014). FAO (2011) provides three examples of best practices for extension management for markets, natural resources and loans for: (1) rural development with special emphasis on land, (2) the participation of small coffee producers in high value markets through a classification called protected origin (for example, Marcala Coffee), and (3) rural credit cooperatives. Extension agents in Honduras act as innovation intermediaries, which is key, for example, for the organization of small-scale coffee producers and for creating links with multiple stakeholders throughout the coffee value chain (Preissing, 2011).

The main agency involved in research and development is called DICTA which reports to the Agriculture and Livestock Secretariat (SAG) of the Ministry of Agriculture. DICTA conducts research based on projects, but does not run a comprehensive research program based on development. The leading roles have been assumed by non-government institutions such as the Panamerican Agricultural School El Zamorano which trains extension students and keeps approximately a permanent staff of 25 men and women working in extension and the Honduran Agricultural Research Foundation (FHIA), created by an international banana company.

At present, a joint government and donors initiative under discussion suggests the creation of a National Agricultural Research and Technology Transfer System (SNITTA) which would be made up by a National Science and Technology Council (CONACTA), a Technical Secretariat, a Projects and Planning Unit and the Fund for the Development of Research and Transfer of Agricultural Technologies (FONACTA).

Other extension programs with private financing – NGO and private companies – considered the most relevant, include the Small Producer Support Program (PAPP) funded by the Honduran Coffee Institute), the Honduran Agricultural Research Foundation HONDUPALMA and HONDUPALMA ECARA (farmers company) and the PROLANCHO Foundation, which in 2009 employed 10 extension workers.

66. The Global Agriculture and Food Security Program (GAFSP) approved in 2013 the Honduran Government's proposal "Alliance for the dry corridor 2014-2019" for USD$ 40 millions, which seeks to bring 24,000 families out of extreme poverty (over 140,000 people).

6. The development of extension: Analysis of models and methodologies

6.1. International trends

Globally, it has been acknowledged that food security and improving the livelihood of small farmers are basic goals that should be reached in the 21st century. Extension systems are a means to achieve those goals (MEAS, 2010) [67]. To get closer to those objectives, a change should occur away from vertical models, where the farmer is simply a user, towards horizontal models, where the beneficiary, the small-scale farmer, is both the point of entry and exit in research and experimentation. The Technology Transfer Model (TT) has been the most used to date. However, this model has not been the most efficient in fulfilling the development objectives that could be achieved by tapping the multiple functions and roles that farming families and agro-ecosystems provide. In this model, science and technology are under the control of experts, from the definition of problems to the design of solutions.

The IAASTD report (2009) indicates that some countries in Latin America have involved farmers and extension researchers in technological transfer as well as in experimentation. These participatory systems are not only important for capacity-building trainings and technology transfer for low income farmers and women, but are also being used for the genetic improvement of plants or the characterization and management of natural resources (IAASTD, 2009. Vol. III:86, quoting Araya and Hernandez, 2006). A clear example of this is the acknowledgement of the role of farmers in the management and improvement of germplasm. However, there is no real consensus on how to evaluate the potential contribution of farming communities – traditional, first peoples and agroecological systems – in the formal genetic improvement systems.

The main objective of extension has been to increase productivity and in turn increase the food supply while simultaneously reducing its selling price. The reduction of poverty per se, has been but a secondary concern. But recently, an investigative agenda put together to provide comprehensive support to small-scale farmers has been gaining more traction in the ongoing international poverty debate. In Central America, there has been a slow transition from rhetoric to practical actions that respond to real demands of famers. In the institutional discourse, frequently it's said that institutions have evolved from a model based on supply to one based on demand. The weak point has been the inter-institutional links.

Swanson (MEAS, 2010) suggests that when re-focusing extension systems on small-scale farmer groups, the following issues are key:

- Land availability/farm size, for example, people with no land; <0,5 ha; 0,5-1 ha; 1-3 ha; > 3 ha) and soil conditions, including type and soil fertility;
- Water availability (meaning, rain-fed and/or irrigation);
- Worker availability/number and type of family members within each home, such as women, youth, seniors; and,
- Access to markets/distance and road access, as well as to local and regional markets, especially for high value products.

67Burton E., 2010. Changing Extension Paradigms within a Rapidly Changing Global Economy.Professor Emeritus of Rural Development; University of Illinois at Urbana-Champaign; Coordinator, Worldwide Extension Study and; Director, Modernizing Extension and Advisory Services Project.

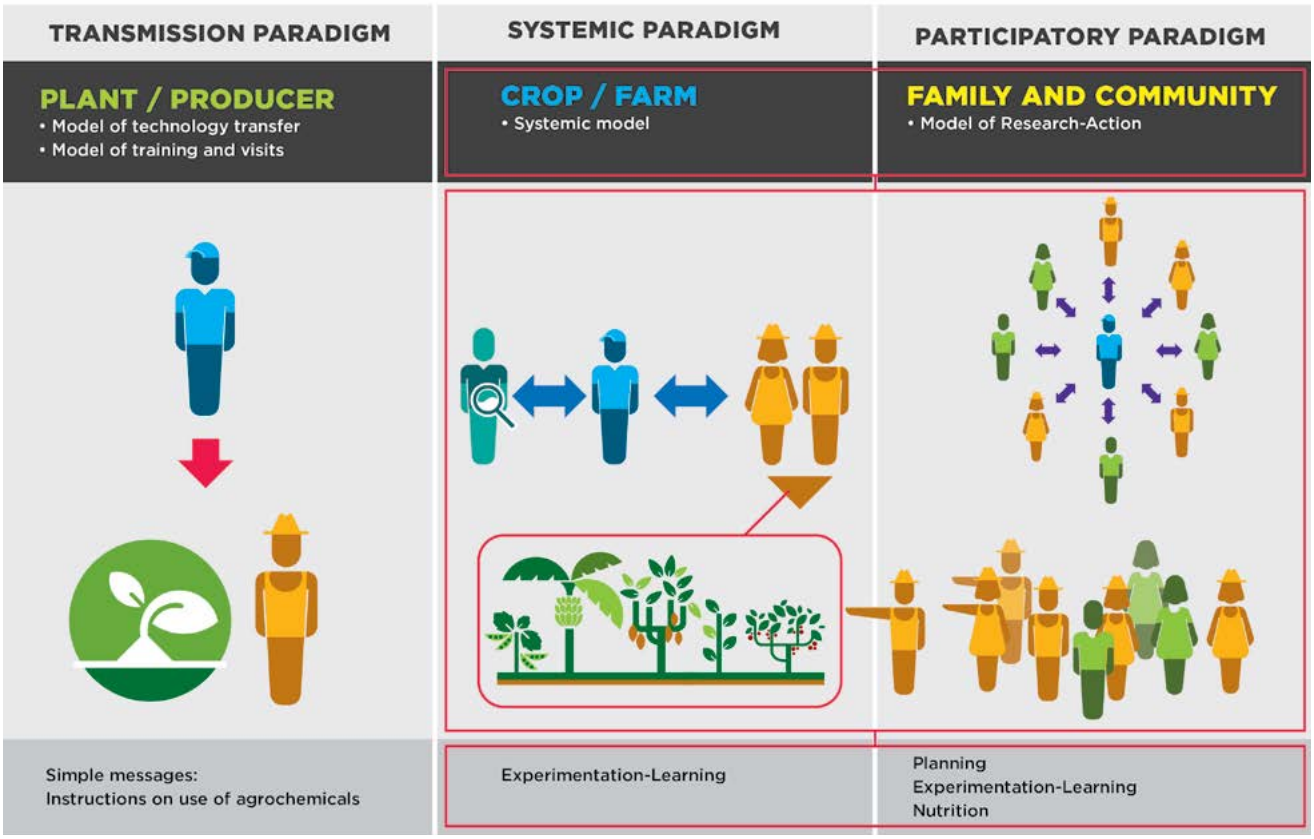
Recent trends emphasize the need for research institutions to take on decentralized management styles. Two different approaches have been suggested[68]: One, is a decentralized structure with operational autonomy, while the other one consists of establishing relatively small agencies with very specific mandates, highly focused in specific regions, products or scientific subjects. [69] (IAASTD, 2009. Vol. III:95).

The IAASTD report (Vol. III, 2009:92) proposes a research agenda that focuses on small farmers and in the areas where they live and work, such as arid regions, semi-arid tropics, marginal lands or hillsides. The agenda should focus less on crops and more on the systems, as well as on ways to diversify production and the use of different available resources.

6.2. Historical evolution of extension models in Central America

IICA (2013) describes paradigm changes in current extension models. According to IICA, to characterize extension requires scrutiny of three aspects: i) the objectives behind the intervention, ii) the technicians' role, and, iii) the tools being used. In practice, models and methodologies (tools) combine different paradigms in different proportions, except for technological transfer (TT) and research-action models, which are the paradigms themselves in action.

Figure 6: Models implemented in Latin America by paradigm



Source: IICA, 2013

68. According to Piñeiro et al., 2003, quoted by IAASTD, Vol III.
69.A focus inspired by the reforms introduced in Great Britain, Australia and New Zeland.

From the transmission paradigm was born the Training and Visits Model (C&V in Spanish). It was supported by the World Bank. Among other objectives, this model seeks to strengthen dissemination by way of "contacts" or "farmer leaders" and, in some cases, through groups themselves. Extension agents report back to the decision makers on what farmers (trained by said agents in bi-weekly trainings) consider their main priorities and/or problems (IAASTD), 2009).

In 1969, as a result of the criticism of the transmission paradigm (whose main tool was the technology transfer extension model, which resulted in only a minority receiving assistance, social inequality and the deterioration of the environment), the Freirian paradigm emerged[70]. This paradigm's most important contribution was introducing the horizontal concepts of communication, dialogue and team building, therefore guaranteeing that everybody would learn something. The relationship between technicians and producers within the dissemination paradigm focuses on persuasion, while in the Freirian one the focus lies on creating a horizontal relationship in which technicians promote producers' awareness and empowerment, considering them to be the primary actors of their own transformation (IICA, 2013).

During the 1960s, the Freire paradigm had wide influence[71]. Its chief design feature consisted in including all main actors of the extension process within the research itself (applied science) to produce sought changes. The research is conducted within a wider framework which rests heavily on community involvement. This approach was triggered by the widening gap between research and action, as well as the need to face social issues affecting the population. It became necessary for people to become part of the process and share their own concepts and know-how as full-fledged co-research partners.

From the systemic perspective[72], the extensionist is not an agent of exogenous change who brings with him technology nor is he a facilitator for radical social change (Freire). Instead, the extensionist interacts with the researcher to translate knowledge into information, and then interacts with producers to transfer information into knowledge for later action (Rolling, 1990)[73]. Rolling considers that within developing countries the main problem is the lack of interaction between research and extension.

During this same period, a new participative model was born, known as the Farming and Extension System Research Model (FPRE[74]). According to the IAASTD report, the effectiveness of this model is up for discussion although it's undeniable that within it, the subsistence producers' needs are visible, and it stimulates the multi-functional nature of agriculture and connections between different scientific disciplines.

70. IICA's Rural Development magazine at the time did a lot to share those ideas through authors such as J. D. Bordenave, J. Bosco Pinto and I. Ansorena.
71. Sociologist Orlando Fals Borda is the main exponent of the research-action paradigm.
72. Questions about the dissemination paradigm were also being made from Europe and Australia (basically because environmental problems were also starting to affect developed countries) and they adoped the systemic approach. During the 1980s, N. Röling developed the idea of AgriculturalKnowledge and Information Systems, AKIS.
73. Röling (1990) describes AKIS as the group of institutions, organizations and people within the farming sector as well as their relations and interactions, involved in the generation, transfer, storage, recovery, inclusion, dissemination and use of knowledge and information.
74. . Promoted by NGOs, grass-root community organizations, universities and the Advisory Group for Agricultural Research (CGIAR) and which designed local guidelines for the FPRE. In this model, feedback came directly through the diagnostic surveys conducted by multi-disciplinary teams, by the interactions taking place at farm-level between researchers and farmers for the design of technology, the tests and adaptations and by the coordination of visits to farmers and research stations.

The FPRE is based on producers' own capacities and has adopted several different names such as Research-Action and Participatory Learning, Producer Research Circles, Community Forestry Development, Participatory Development of Technologies and Peoples Participatory Program[75]. Communication and training implemented through the "Farmer to Farmer" methodology in Central America to improve soil fertility and control erosion was based on the FPRE approach. (IAASTD, 2009). The Participatory Plant Breeding project (FP), which was considered especially efficient to research grains, beans and roots, stems from this project.

Table 2: Knowledge Models according to their respective purposes

MODEL	CHARACTERISTICS	PURPOSE
TECHNOLOGY TRANSFER	Innovation; linear communication based on hierarchy; farmers as passive agent of knowledge at the service of public interest.	Increasing productivity on the premise of replaceable technologies, simple messages, and simple practices; keep competitiveness in the market. Not apt for the promotion of complicated technologies and management practices, complex behavior and innovation changes made to fit the landscape
RESEARCHER-PRODUCER COLLABORATION	Interrelated innovations, multiple sources; flow of communication from varied sources, through social networks and organizational links between independent actors serving their own interests.	Developing livelihoods that are socially equitable and environmentally sustainable at a local level, landscape management and empowerment of the multiple interested parties. Not apt for the rapid dissemination of messages and simple practices, alternative technologies.
ARRANGEMENTS/ CONTRACTUAL AGREEMENTS	Science as an on-demand service to support production; communication flows based on the needs of processors and retailers according to market requirements; farmers are agents linked to company's interests.	Performance sustainability and company profitability. Contractual agreements may trap low income farmers in unequal relationships, making them dependent on the company. Its focus on the crops does not allow for the promotion of the system as a whole or innovation at a larger scale.
LINK WITH CHAINS	Science as a pool of knowledge and a specialized skill to solve problems; structured communication between the product/ technology development teams with constant market information; farmers as members of the team sometimes, but mainly as market agents serving the interests of the companies.	Maintains that the motor of innovation is the commercial sector, empowers consumers to articulate demand and reinforce science. Improve livelihoods which are environmentally sustainable due to pressure from citizens and regulations.

Source: IAASTD Global Report, 2009.

75. All these versions of the participatory model share a series of generic characteristics: focus on the student, adapted to the area, ecologically informed, and the use of interactive communication and facilitation instead of extension skills (Chambers and Ghildyal, 1985; Ashby, 1986; Farrington and Martin, 1987; Gamser, 1988; Biggs, 1989; Haverkort et al, 1991.; Ashby, 2003, quoted by the IAASTD. The FPRE model has been used at a greater scale in the development and promotion of tree species for multiple use farming exploitation in Kenya (Buck, 1990).

6.3. Mainstream extension methodologies

Systems and extension models in Central America have undergone a series of transformations. According to Ardila (2010)[76], during the last two decades, extension in Latin America has experienced four broad transformations:

- The first one consisted of extension financing and/or technical assistance services being offered by direct beneficiaries; which represented a new angle on the "farmer's relationship with the innovation-technology chain and researchers".

- The second transformation consisted of the decentralization of extension services. The majority of extension services were organized parallel to the so-called national farming research Institutes (INIA). However, both services were generally provided by the same organizations and had a centralized system consisting of experimental stations and regional agencies. Their main objective was sharing research results with the farmers, while breathing life into the

previously mentioned linear model (now obsolete).

- The third transformation focused on service outsourcing, which can also be considered as decentralization. In it, some extension services and technical assistance began to be provided by private companies, NGOs and producer organizations. In some cases, these service providers work with public funds, while others did so with their own resources. Outsourcing represents the birth of alternative extension and technical assistance markets.

- The fourth transformation places its focus on the producer as an individual, and transfers it to the concept of family agriculture. This is where we begin to see the non-refundable cash subsidies to producers (for example, the "Pound for Pound" program in Nicaragua), and may also include non-cash transfer in technology, knowledge and other aspects.

IFPRI (2014)[77] shows that farming extension systems in Central America are in the process of change. There is a trend towards a mix of public, private and NGO systems, or in other words a pluralist extension system[78]. While in El Salvador, Honduras and Guatemala this is the prevailing framework, in Panama and Nicaragua it's the public system that continues to prevail. Swanson (2008) suggests that farming technology will continue to be developed and sold by the private sector, and as a consequence, the technology transfer process will eventually become wholly private. And in spite of the continued prevalence of public systems in Central America, there will be a gradual change towards public-private and pluralistic extension and assistance.

Current extension methodologies tend to be based on models of technology transfer, trainings and visits and participatory models. Among the methodologies being used, are: a) agricultural community extension; b) farmer experimentation; c) entrepreneurial technical assistance; d) field schools; e) demonstration plots; and, f) field days.

76. IICA. 2010. Rural extension for the development of farming and food security. Conceptual aspects, situation and a vision of the future.
77. http://www.worldwide-extension.org/the-americas/central-america.
78. Narrowly defined, pluralism includes public, private and non-government sectors to participate in extension services and agricultural advisory. Conceived in general terms, a pluralist system of advisory services includes the public and the private sector – comprising corporations, companies and farmer organizations – as well as NGOs that lend said services. Farming education institutions, as well as research and development institutions are also part of a broad-based pluralist extension system.

Table 3: Main characteristics of the most frequently used methodologies in Central America

METHODOLOGY	DESCRIPTION
COMMUNITY FARMING EXTENSION	Training/educational process that emphasizes the promotion of the population's ability for self management.
FARMER EXPERIMENTATION	Oriented towards inducing spontaneous technological change, with a high level of adoption, allows for the adjustment of technologies for the efficient use of available resources. Places strong emphasis in horizontal dissemination (*).
FARMER TO FARMER PROGRAM	Training/educational process that includes farmer experimentation, exchanges and horizontal dialogue amongst farmers. This is popular education focused on learning by doing, through action-reflection-action processes in the search of alternative technologies. Theorical-practical training, focused on farmers learning why a technique works or doesn't work, and promotes the generation of new techniques.
FIELD SCHOOLS	Methodology involving experiential and practical learning based on non-formal education for adults. The key point is observation, analysis and shared decision making regarding crop management. This is a process characterized by a "learn by doing" motto.
DEMONSTRATION PLOTS	Group methodology, managed by the producer in his community to motivate small-scale low risk technological change meant to show the feasibility of certain technologies in comparison with the traditional practice.
FIELD DAYS	Workdays conducted in the fields in areas where best farming practices are applied. It is hoped that participants will observe the new practices or innovation techniques while personal contacts and exchange is created or facilitated.
ENTREPRENEURIAL TECHNICAL ASSISTANCE	Stems from the demands of producers considered as customers, mostly Independent, and who are formally or informally organized to hire consultants or train for specific tasks or subjects, depending on their specific needs.
LOCAL AGRICULTURAL RESEARCH COMMITTEES (CIAL)	Inclusive methodology that allows to create new knowledge within the same community. The members of a CIAL, chosen by their own community, have specific roles and are made up of at least one leader, one secretary, one extension agent and one treasurer. There are eight basic steps: Feedback, Analysis, Evaluation, Experimentation, Planning, Election, Diagnosis, Motivation.
EXTENSION METHODOLOGY DIRECTED BY OBJECTIVES (EDO)	Methodology meant to transfer technology based on trainings and field visits. EDO is permanently providing training to extension agents, while making regular field visits to producers, establishing production goals with farmers, measuring results and evaluating profitability.

(*)[79]

Some methodologies, like the Farmer Field Schools (FFS) have achieved great results and are widely popular. An example of this is the Family Farming Plan in El Salvador which builds on the original FAO methodology from 1989. There were several different modalities of application, while includes a vertical type of learning, in spite of the fact that the literature defines FFS as a horizontal learning method. Another of the variations consists of not choosing topics for the FFS in a participatory way with the producers. In other cases, the FFS is a way to convene producers without taking into account their geographic proximity, their type of organization, their educational level or agricultural activities. If FFS is used solely to deliver farm technology packages, one loses the chance to create local skills within farmers' own social structures.

79. Compared to the formal GyTT process, farmer experimentation has the advantage that the whole research process (testing), adaptation and adoption of a technology is conducted by the same actor (farmer), within their real environments, thus making it easier to spontaneously adopt or reject technologies.

A positive example of the application of FFS is the Farming for Basic Needs project (A4N)[80] implemented by CRS in Central America (CATIE, 2012). An FFS-crops and FFS-farm were implemented to improve assistance services being provided to families dedicated to subsistence farming. The FFS-farm[81] sought a more comprehensive learning of the agro eco-system.

FFS methodologies have been widely disseminated and used by multiple projects and promotors. However, it's important to keep in mind that the model is not always used with the necessary complexity and comprehensive approach it requires. And without including the whole support structure needed for best results or providing the necessary institutional support and trainings for technicians, or when not adhering to timeframes to conduct all pertinent activities, FFS does not turn out to be an efficient methodology[82].

Local Agricultural Research Committees (CIAL) make up another participatory methodology used in Central America. They encourage the generation of knowledge within the communities themselves. A CIAL bases itself mainly on research conducted by farmers appointed by their own communities to take a closer look at specific issues identified through a participatory diagnosis.

According to Ashby et al. (2000), each committee sets up a small fund to cover the costs and risks of the research. The CIAL are then put in charge of a trained facilitator, who helps empower each of the members of the group by using the methodology itself. At least four experiments are required to acquire a good understanding and knowledge of the methodology's basic concepts. And in contrast to FFS, the CIAL runs a series of experiments and identifies different possible solutions for the specific problems being faced from a wide variety of technological angles (CATIE, 2012, quoting Braun et al. 2000).

Figure 7: The eight basic steps for the development of a "Local Farming Research Committee" (CIAL)

Source: CATIE (2012), taken by Ashby et al., 2001

80. Evaluation of Implementation Strategies and the Sustainability of the Extension Model based on the Promoters of the "Farming for Basic Needs" project (A4N) implemented by Catholic Relief Services – USCCB.
81.The objectives of the FFS-farm Project A4N were: organize the farm based on its ecological potential and in accordance to its economic and social limits, as well as to expand the sustainable farming system; manage resources to improve the farm; and increase the farm's productivity to help family food security (Pilarte 2011).
82. Discussions in GWI Alliance Tables in El Salvador and Honduras.

The implementation of EDO in El Salvador between 1992 and 2000, led to the creation of over 2,500 community circles, and was used to transfer new technologies to 10 local producers per location, each of which shared this technology and know-how with an equal number of people. Through this method, whenever an extension agent provided direct assistance to ten producers, indirectly the assistance reached 100 producers (MAG 2001). Based on CENTA's reports, the biggest achievement in extension was the assistance provided to 63,000 small and medium producers (14% women) through both the trainings and personalized visits. Additionally, basic grains production was increased by 50% over the national yield average and milk production increased by 100% for approximately 125 cattle ranchers who were provided with cutting edge technology (MAG, 2001).

6.3.1. Current Extension Methodologies in Nicaragua

In 2007, public extension systems in Nicaragua once again offered free extension services for the poorest producers, especially those working in productive activities linked to food safety, and natural resources improvement and protection. However, to some extent a model of outsourcing continues being used (Ortiz, R., 2009).

> Nicaragua's public system currently combines Rural Promotion and Farmer Field Schools (FFS), where the main actors are both promoters and producers, and works jointly with facilitating agencies such as the Ministry of Family, Community, Cooperative and Associative Economy (MEFCCA), the Ministry of Agriculture and the Nicaraguan Institute of Farming Technology (INTA). This program's current structure (2014) includes 165 technicians, 29 agencies, 5regional headquarters, 5 CDT and three experimental stages. To date 46,501 producers in 129 municipalities have received assistance from 2,500 promoters.

The Field School and Rural Promotion methodologies are likewise used by NGOs. For example, the Farmer to Farmer (PCAC) methodology is a program implemented by the National Union of Farmers and Cattle Ranchers (UNAG) that supports individuals as agents of change via technical assistance. They carry out educational processes and offer a permanent local presence. The Farmer to Farmer program has been working since 1986, and offers its services in 16 departments, providing direct assistance (with the help of 1,800 promoters) to approximately 22,000 families made up of small and medium producers, plus approximately 60,000 members of the UNAG. The success of the program itself depends largely on the exchanges which take place amongst the producers with a "learning by doing" approach.

The Rural Promotion program [83] has 2,500 trained promoters (40% women) and approximately 3,500 still in training. And although they don't receive any wages for their work, they do receive productive incentives (inputs, products, direct assistance) and belong to the extension network for training and learning.

During the 2000-2006 period, public extension systems used other methodologies such as the Technical Assistance Fund (FAT), that divided its attention between favorable and less favorable areas (where there was more vulnerability to climate issues). Varied modalities were used to assist both subsistence producers, as well as producers overall. Services were free for subsistence producers, and co-funded for producers when they could take on the costs. Technical assistance was provided individually or in groups through programs such as FFS, within farming plots themselves, through workshops, in demonstration tours and/or field days.

83. INTA (2013), http://www.inta.gob.ni/: Rural promotion agents hold a very special place as leaders or agents of change in the communities. They are all volunteers and earn no wages. They provide information and knowledge through transfer processes and trainings amongst promoters and producers.

6. 3. 2. Current extension methodologies in El Salvador

Since 2001, with new openness to the private sector, CENTA's public extension services (reduced to 29 extension agencies and 109 extension agents) implemented the Training & Visits Methodology. In 2010, they began to deliver agricultural packages, especially for beans and corn. The Technology Transfer Unit spent half the year preparing the logistics of distribution and the delivery and liquidation of the program, which reduced CENTA's presence in the field and weakened their extension services.

With respect to technical assistance, CENTA reduced the number of agencies from 75 in 1993 to 60 in 2000. A new extension model that focused on goals was implemented. This model was based on determining which communities had operational farmers' circles so that technicians could conduct periodic visits and handle inquiries or carry out field activities.

With the Family Farming Plan for Food Security/PAF-SAN providing coverage for 132 municipalities and 86,032 families, 28 extension agencies opened doors with 283 extensionists. It meant that every technician provided assistance to 304 families. This included more participatory models, (traditionally implemented by NGOs) such as field days, tours and field schools.

Public assistance methodologies that include promotion include the Demonstration Family and Home Workshops. CATIE (2012) stated, "it's clear that an extension model implemented through community promoters represents a highly efficient mechanism for the participatory dissemination of knowledge to large numbers of communities and families. Furthermore, it promotes the empowerment of all members of the community, including women and youth."

6.3.3. Current extension methodologies in Honduras

As in Nicaragua and El Salvador, extension systems in Honduras during the last decades have followed a Technology Transfer Model. With structural adjustment programs and the dismantlement of public extension systems, private frameworks offered by agrochemical companies eventually became consolidated. At the same time, more horizontal and participatory models came into practice, implemented primarily by NGOs and producer associations in a sustainable agriculture framework.

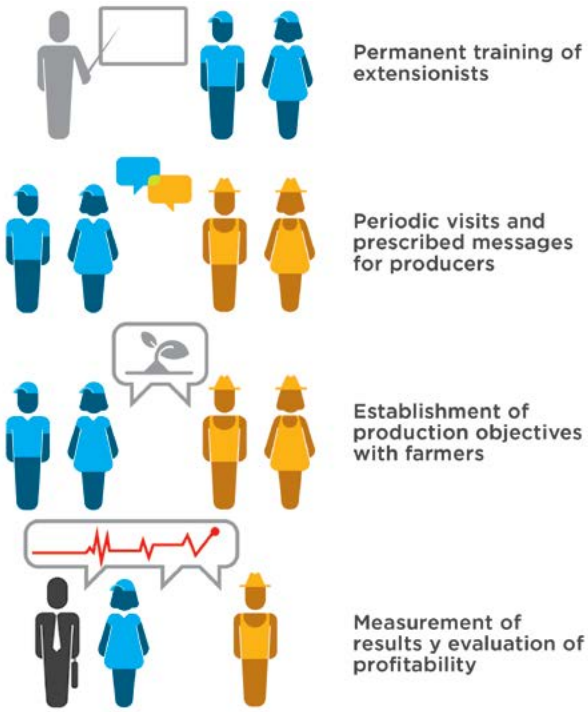
Currently, DICTA is an important source of technicians for projects carried out by international donors. It is these projects that define which extension models to adopt and not DICTA as the government agency. Up until the previous government, the Livestock and Agriculture Secretariat was never linked to a specific extension policy. It's presence in the field was limited to a productive technology package project and the productive solidarity package (FAO, 2011)[84] . There exist deficiencies in the amount and quality of activities held both in controlled environments as well as on farms. And experience suggests that it's just not possible to keep a direct relationship between extensionists and a large number of farmers, which is what happens whenever technological packages are delivered.

Data from the National Farming Survey (2007-2008), show that only 16.5% of farmers (44,704) received technical assistance, the majority working less than 5 hectares. These services were provided mainly by NGOs and through international cooperation projects. Technical assistance services provided directly by a government agency such as DICTA included only 3.5% of farmers that received assistance. This data vastly differs from the numbers handled by DICTA, whose yearly reports show that they provide assistance to 160,000 farmers with a team of 120 extensionists[85].

84 Good practices in extension management in Central America.
85. Systematization of an extension farming Degree specializing in sustainable farming (Villeda and Soza, 2012)

At a forum about extension services held in Honduras (September 2013)86, there was discussion that extension should be focused on three sub-sectors: i) Subsistence agriculture: with personalized assistance provided by the state, which should start at a central government level and reach down to local governments; ii) Transition agriculture: guided by business plans for attending to the real needs of organizations and communities; iii) Commercial agriculture: the forum recommended monitoring by the state to make sure that farming practices are the appropriate ones and pollution and soil degradation is avoided. It was also affirmed that any assistance provided should increase production capacity in relation to the markets. It was proposed that assistance shouldn't be free, but rather based on keeping technicians working in the projects but without affecting production costs.

Figure 8: Methodology of extension guided by objectives (EDO)



7. Challenges and opportunities for rain-fed Agriculture Extension in Central America

In this section, we will discuss some of the challenges faced by extension services for rain-fed agriculture in the region. This section and this document ends with a look towards the future with respect to reasonable expectations for extension in the present-day context.

7.1. Challenges for extension

Throughout this document, several references have been made to the many obstacles and challenges currently being faced by extension systems in Central America. Some of the most relevant for an extension system which fulfills the needs of small-scale farmers of rain-fed agriculture in a given territory, social structures and local institutions, are the following:

86. Honduran symposium on Farming Extension. 2005. Background, current situation and perspectives. Summary, conclusions and recommendations.

- Inter-agency and inter-sectoral coordination
- Coordination between research and extension: local+scientific knowledge
- Extension from a territorial perspective with adequate resources and decision making power
- Global national extension budget
- Extension services coverage and technical assistance
- Extension systems and farmers' relationships with the markets
- Efficiency of extension: investment performance
- Training and programs to address the comprehensive nature of rural living, knowledge and local learning
- Participatory methods with a pedagogical approach based on learning and adult education

7. 1.1. Inter-agency and Inter-sectoral coordination

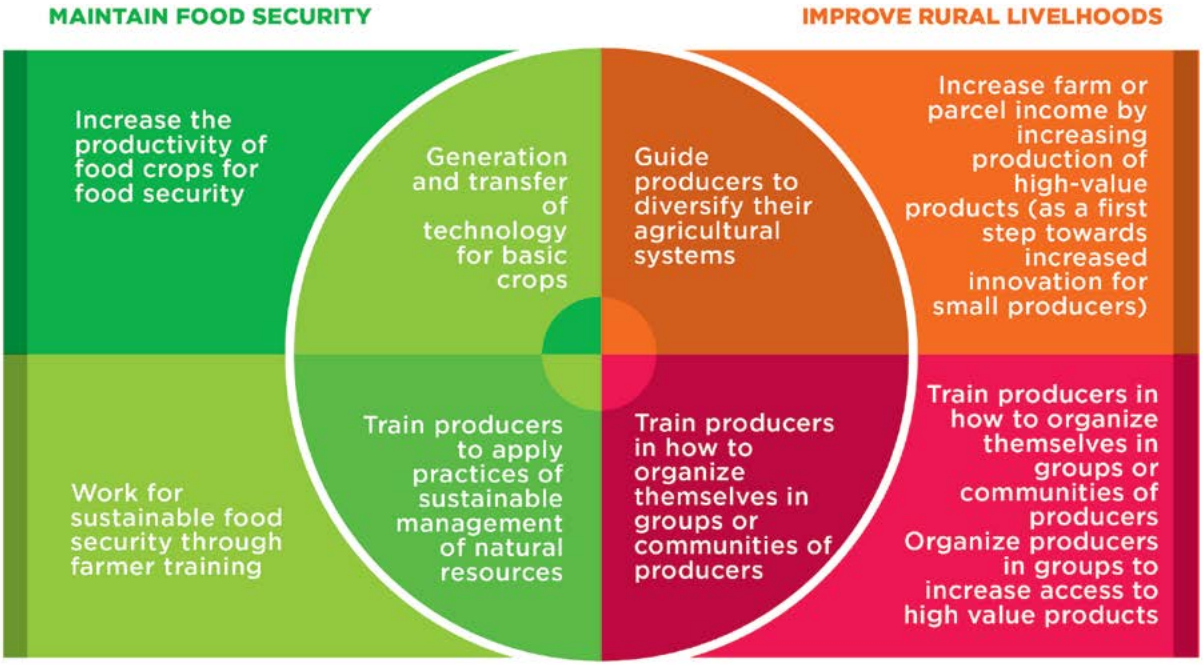
The global interest in unifying systems of farming knowledge also applies to Central America (MEAS, 2014). When faced with challenges such as extreme climate variability due to climate change, volatility of food prices, or the disadvantageous situation of small farmers within the context of free trade, inter-agency or multi-sectoral work - among other solutions - can be helpful. Farming policies, strategies and programs require coordination between the Ministries of Agriculture, Environment and Economy, as well as with research institutions. Small farmers need extension systems that cut across sectors to be able to overcome the multiple challenges they face. El Salvador, for example, has an innovative program called PREP, which involves both the MAG (Ministry of Agriculture) and the MARN (Ministry of the Environment).

One of the main conclusions reached at the International Conference "Revitalizing Investments in Rain-fed Agriculture in Central America" was to embrace complexity. This is the most important challenge at a macro and institutional level, as well as amongst the farmers themselves. For example, understanding the hydrological cycle of water is of great value to understand green water's vast potential – soil humidity – for rain-fed agriculture in Central America. Local soil knowledge and investment in a national soil system to generate soil maps per farm would result in the significant reduction of agrochemical use and therefore in production costs. El Salvador's most recent experience setting up a national soil system has shown that in order to achieve any of these goals, agencies need to work in close coordination with one another.

Part of the above mentioned inter-agency and inter-sectoral coordination is precisely about adjusting each extension system's goals and functions to the national objectives for agricultural development. The World Bank (2010)[87] provides an example of how these adjustments may complement one other.

87. World Bank. 2010. Strengthening Agricultural Extension and Advisory Systems: Procedures for Assessing, Transforming, and Evaluating Extension Systems.

Figure 9. Objectives and functions of extension



7.1.2. Coordination between research and extension: Local and scientific knowledge

The biggest challenge is creating a strong bond between farming research and extension services. The effective link between these two types of agricultural support would guarantee that scientific research focuses on solving the real needs of small farmers within their own territories, and that both local knowledge and practices are included within the design of the research itself. This type of synergy would improve the possibility that producers might adapt new practices.

A review of experiences in Guatemala (Bently and Andrews, 2011) found that the majority of actors in agriculture combine ancestral knowledge, direct observation and personal experimentation with outside ideas. Producers have a profound knowledge of applied botany and are capable of naming almost every plant found in their surroundings. They know their habitats intimately as well as the benefits and harms of plant species in their environments. Women especially have a profound knowledge of the culinary value of wild plants and how to use them in different recipes. They understand that the use of herbicides eradicated "weeds" that were actually very useful in their farming environments, and these were then replaced by other plants which are often useless and even harmful. However, this local knowledge is not enough. Many producers don't understand the reproduction of insects, especially the complete metamorphosis cycle (egg, larva, pupa and adult). Farmers tend to have very basic notions regarding beneficial insects, or regarding the causes for disease. They don't know about genetics and microbiology. Technicians should document, respect and use the local's knowledge as a reference and starting point for their own work.

Another key challenge is how to identify small-scale producers' needs and demands. The research and extension should be generated through joint work in the field rather than through workshops, surveys or mechanical diagnostic tools. Identifying the authentic local demands of the population implies continued communication, empathy, creativity, and mutual respect. Both parties should offer, ask, contribute and synthesize.

In Nicaragua there is process underway with the INTA's Technological Research and Innovation System. This system has four main aspects: Technological Development Centers, Research Stations, Research Farms &

Technological Innovation and the Territorial Innovation Centers. Now, in Guatemala, the guiding principle for the National Rural Extension System (SNER) is that the plots and homes of the community group, especially of the voluntary promoters, constitute Learning Centers for Rural Development (CADER).

7. 1. 3. Extension from a territorial perspective: Adequate resources and decision-making power

Decentralizing public extension systems would allow the design of a new type of extension that would depart from the needs and opportunities of families within their own contexts and territories. When decentralizing extension, it's important to ensure that the transfer of responsibilities to the local level is accompanied by financial support and organizational preparation. Past experiences in Central America have shown that when central Government institutions open local and regional offices, resources may be so limited that they're unable to do what they were meant to do. Or, when working with municipalities, they have not been adequately prepared to share responsibilities such as follow up and quality control.

Extension based on territories implies decentralized or deconcentrated agencies which have a considerable level of operational autonomy and physical infrastructure, as part of a system that is complemented and supported by the private and academic sectors (RELASER, 2012).[88]The World Bank (2010) suggests that the decentralization process of a national extension system could be influenced by issues such as a clear legal framework and a governance structure that defines the extension levels to be decentralized. For example, there should be a regulation that describes the tasks to take place at every level, as well as of coordination mechanisms between agencies. Another important issue is not limiting the extension system to the duration of the term of a government administration; and taking advantage of the broad participation of various actors that support agriculture. This could be coordinated through advisory commissions or directive bodies that represent principal groups of stakeholders, such as women, small-scale farmers and indigenous groups.

Another key issue has to do with strengthening both administrative and technical management for extension services at a local level. Providing appropriate and comprehensive education as well as team building experiences for extension agents is essential to the process, as well as having adequate information technologies to collect and process information for each municipality.

A territorial extension systems that responds to local needs and opportunities must have the necessary financing, as well as the power to make decisions that will have an impact on the livelihoods of the population that lives there. This extension system must be strategically linked to applied research in the territory.

7. 1. 4. The overall national extension budget

The three national institutes, CENTA in El Salvador, focused on research and extension; INTA in Nicaragua, focused on research and technology transfer; and DICTA in Honduras, focused on research, are all financed through direct allocations from the state budget to support infrastructure and wages. However, all these agencies rely on national science and development funds, as well as contributions from bilateral and multilateral donors to support their operating expenses.

As has been described throughout this document, ever since public institutions dedicated to supporting agriculture have been dismantled and structural adjustment programs were implemented, public budgets

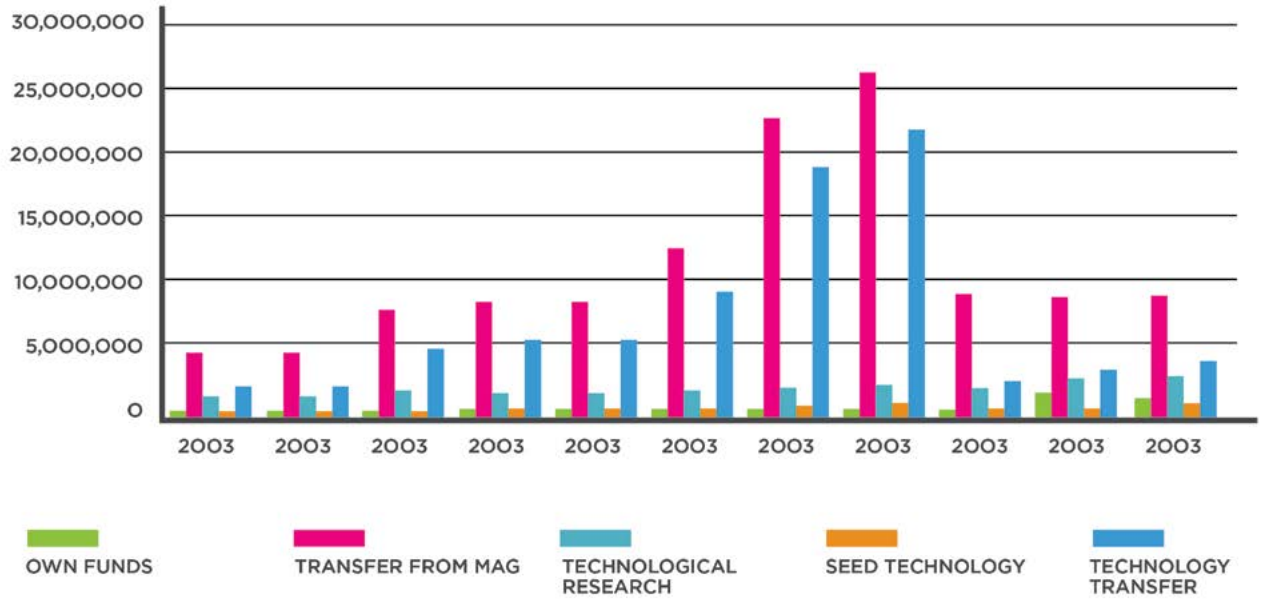
88. Institutionality of rural extension and public-private relations. (www.relaser.org).

for extension and research have been insufficient. This limits the ability of public institutions to help small producers. During the 2000s, farming support budgets averaged only 2% of the GDP in the region, even when agriculture represented 15% to 30% of the economies in these countries. Since 1980, public investment in farming in Central America decreased by up to 70%. And while in 1979, 18% of all foreign aid was destined for agriculture; by 2009, this percentage was only 6%.

In El Salvador for example, priorities for the Ministry of Agriculture's and CENTA's annual budget are based on government plans and the strategic priorities of each presidential administration, as shown in figure 9. Between 1999 and 2004, the MAG's (Ministry of Agriculture) main focus was on technological innovation and infrastructure investment, which limited CENTA's technical assistance work with farmer organizations and federations.

It's difficult and complex to conduct a public investment analysis of national extension systems, given that available information is uneven. Nevertheless, it is obvious that the lack of funds for extension programs represents one of the primary obstacles for rain-fed agriculture.

Figure 10: El Salvador: CENTA's annual budget 2003-2013 (US$ current) [89]



Source: Prepared by the authors based on information provided by the Ministry of Finances (http://www.transparenciafiscal.gob.sv/portal/page/portal/PTF/Presupuestos_Publicos/Presupuestos_votados)

In the graph we see the evolution of public investment in El Salvador. The significant increase shown between 2006 and 2010 is owed to the fact that in 2006 the cost of farming packages, US$ 2,817,885, was assigned to CENTA as part of the technological transfer budget. In 2007, this cost was increased to US$ 3,376,960; in 2008 it was US$7,262,280; and in 2009 and 2010 it reached its maximum levels (US$ 16,576,175 and US$ 19,545,555, r

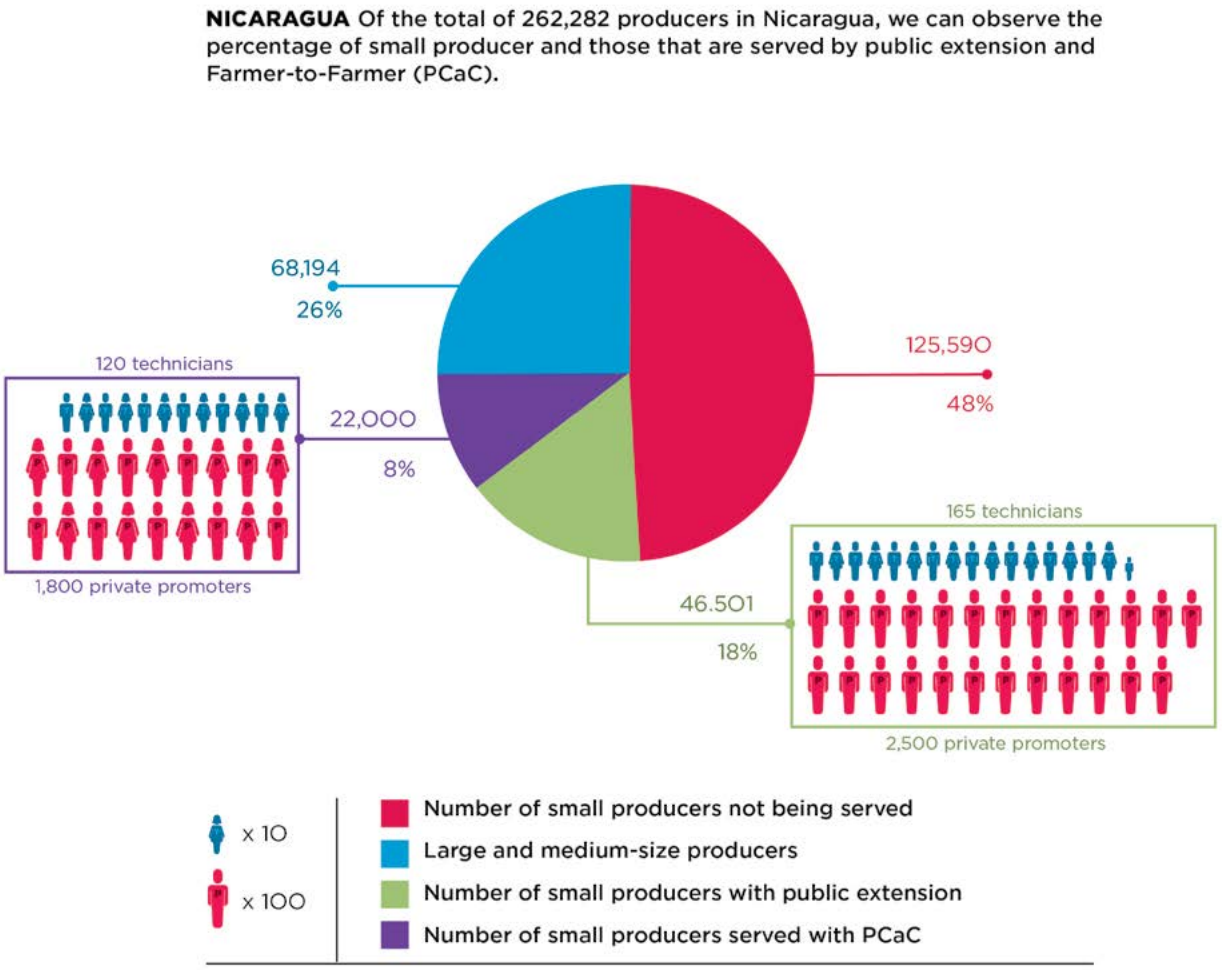
respectively). However, distributing resources for farm technology packages does not actually mean that the actual transfer of technology took place.

89. Significant increases (Illustration15) between 2006-2010 are owed to the fact that in 2006 the cost of farming packages for USD$2,817,885 was assigned to CENTA as part of the budget for technological transfer. In 2007 this cost increased to USD$3,376,96 reaching its highest level in 2010 (USD$19,545,555).

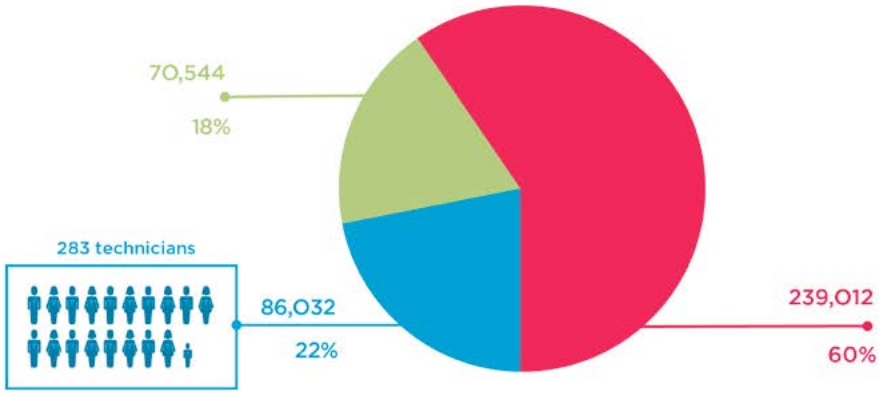
7. 1. 5. Coverage of extension services

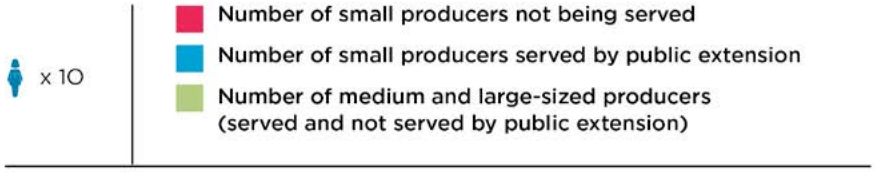
Based on available country data, there is a notoriously low number of producers and/or families receiving extension services and technical assistance. Only 24% of small producers in Nicaragua receive extension services (CENAGRO, 2011), 26.5% of small producers in El Salvador and 16.5% of all producers in Honduras. This reflects, in part, the consequences of budget cuts and the dismantlement of national systems due to structural adjustment.

Figure 11: Coverage of extension with available resources of public extension agencies

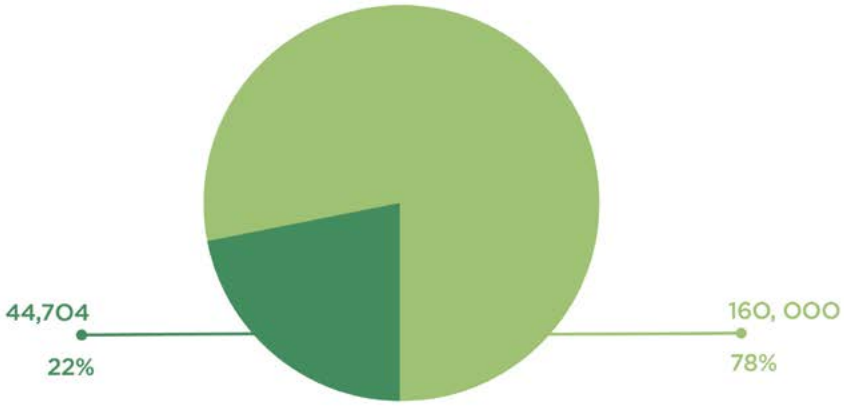


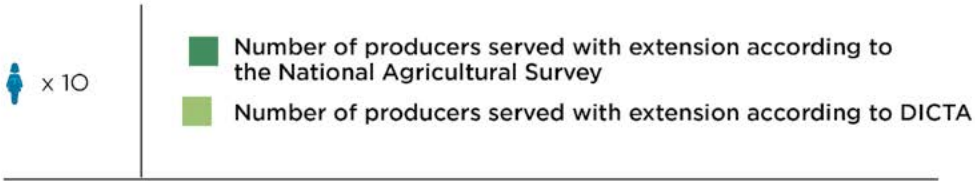
EL SALVADOR Of the 395,588 producers in El Salvador, 325,044 are small producers. We can see the percentage of small producers and how many are served by public extension.





IN HONDURAS there are no statistics on the number of small producers and there is a discrepancy among sources about the number of producers served. Of 270,000 producers, DICTA counts 160,000 served, while the National Agricultural Survey counts 44,000.





In Nicaragua and El Salvador, there have been a series of efforts towards increasing coverage. An example is the implementation of more participatory methodologies, such as technical field schools. For its part, Nicaragua works with 18,000 producers in field schools, not including the 2,500 rural promoters which are also being trained. And concurrently, through training rural promoters, in its eastern and western regions, El Salvador is utilizing principles of horizontal and adult education methodologies, on topics relevant to the farm and the home. Each extension agent is responsible for providing direct assistance to 16 pilot families, who at the same time share knowledge and technologies with 18 other families. There are no studies to determine the impact of this increased coverage after these new methodologies were applied.

7. 1. 6. Efficiency of extension: Investment performance

The yield of investments in extension is one of the least studied issues in the region. The FAO (2010) finds that even when it's a well known fact that certain types of investment are able to achieve high social and economic benefits, these are not always considered a priority within budget allocations. In Central America the common practice is to rely on international funds to finance extension services. Therefore it becomes extremely important to understand the impacts of varied investments and public programs and their bearing on agricultural performance, food security and poverty. A fuller understanding may help guide public investments towards higher achievements.

Several studies cited by the FAO (2012) [90] point out that impacts on productivity are higher from research spending as compared to non-research spending. Investment in research, often related to extension, has been determined to be the most important source of growth in farming productivity (Fisher, Byerlee and Edmeades, 2009, quoted by FAO, 2012). In this regard, Evenson obtained interesting results (2001, quoted by FAO, 2012) when he analyzed 375 applied research programs and 81 extension programs. He found that 80% of applied research programs and 75% of extension programs registered rates of return – in terms of agricultural productivity[91] – exceeding 20% and in many cases even 40%. Recent studies (2011) in different parts of the world also support these results. In Thailand for example, research had a positive effect in overall factor productivity and a marginal return rate of 30%. Extension services in Uganda show return rates between 8 and 36%.

To show the importance of investment types in agriculture, a Latin American study (López & Galinato, 2006 quoted by FAO) looked closely at the efficiency and equity implications of how rural expenses were structured. They determined that, overall, public expenditure in rural areas had very positive effects and important outcomes in the farming GDP per capita, but that the composition of public spending as far as subsidies – referring to direct subsidies for fertilizers and seeds; known in Central America as technological packages – was much more important. The proportion of rural expense meant for subsidies from 1985 to 2001 varied from less than 10% to almost 90%. One of the conclusions is that the proportional increase in subsidies, while keeping the total expenditure constant, significantly reduced the farming GDP per capita. According to expert estimates, just by reassigning 10% of the rural public expenditure of subsidies to public goods (such as research, extension infrastructure, etc.) a 5% increase per capita in farming revenues can be obtained.

90. The Global State of Agriculture and Nutrition: Invest in agriculture to build a better future.

91. The basis of calculations is Total Factor Productivity (PTF), to represent all sources of productivity increases in agriculture. PTF is an index of measured products divided by an aggregated index of inputs and physical assets (land, labor, machines, cattle, chemical fertilizer, and pesticides). An increase in the PTF represents that part of the growth of production that is explained by technological advances, human capital development, improvements in physical infrastructure and government policy, as well as factors that are not measured such as the quality of inputs or a decrease in availabilty of natural resources (Fischer, Byerlee and Edmeades, 2009).

Table 4: Proportion of subsidies and public assets in rural public spending In Latin America and the Caribbean

COUNTRY	SUBSIDIES AS A PROPORTION OF RURAL EXPENDITURE IN %	PUBLIC ASSETS AS A PROPORTION OF RURAL EXPENDITURE %
GUATEMALA	27	73
HONDURAS	9	91
NICARAGUA	37	63
BRASIL	87	13
MÉXICO	66	34
PARAGUAY	32	68
REPÚBLICA DOMINICANA	80	21
URUGUAY	19	82

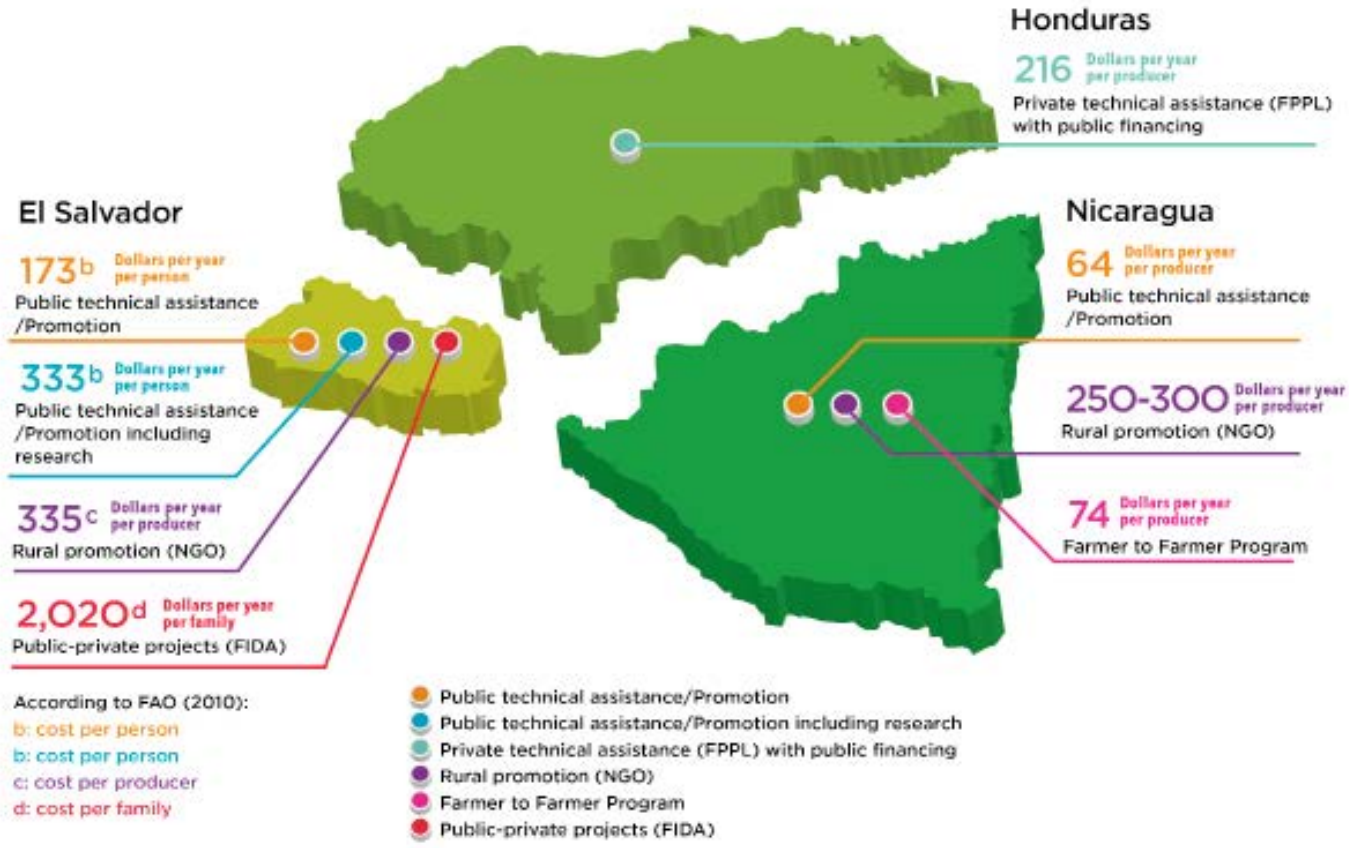
Note: Proportions are yearly averages from 1985 to 2001

Source: FAO 2011 taken from López & Galinato, 2006

The lack of information and deficiencies in updated information in almost all the Central American countries limits the analysis of how efficient extension services are or have been for small-scale producers. Specialized studies are necessary to determine the return of investments in farming, and more specifically of investments made in extension and research. There are a number of unresolved questions: What has been the overall production increase? What has been the increase in crop productivity? What has been the productivity increase in the farm or plot? How has conservation and restoration of soil, water or ecosystems improved? How has the revenue, knowledge and learning of small-scale producers been improved? All this information would be very useful to make decisions on how to better use resources which are obviously scarce. Likewise, clarity on the investment required to educate producers and their families to improve their ability to face risks (pests, droughts, etc.) and their mastery of the environment is important, making it possible to find local and lasting solutions, as well as helping them adapt to changes due to climate variability.

Available information indicates that the costs of extension services show considerable variation between each of the countries. In Nicaragua for example, promotion costs seem to be more efficient when conducted by INTA or UNAG, which allows for a greater coverage of producers and lower costs. However, determining the actual efficiency of these services requires more specific studies.

Figure 12: Annual costs of extension services per producer (US$/per year/producer)



In El Salvador, with the PAF-SAN it was reported that each extension agent provides assistance to a total of 304 families. The average cost is of $173 per person. And when research and seed expenses are added, the cost increases to US$333 per producer. For their part, NGOs show costs between $335 and $600 per user. Costs in projects with public-private contribution, and with participation from FIDA[92], reach up to $2,020 per family. FIDA has 9 projects at a total cost of US$ 279.2 million to provide assistance to a target population of 138,200 families. In Honduras, data provided by the the Fund for Hillside Farmers Project (World Bank, 2006) [93] show costs of $216 a year per family[94]. In general terms, it hasn't been possible to determine how investments are actually performing. It is important to conduct up-to-date studies and establish clear criteria that will be able to measure said performance.

Investment and costs analysis should cover private extension services and their differences in impact caused by privatization of extension services due to structural adjustment. A large number of NGOs and agrochemical companies are working in extension. But there is still no clear idea on the impacts of this trend. Have services

92. http://operations.ifad.org/web/ifad/operations/country/voices/tags/el_salvador. Consulted in October 2013.
93. Institutional innovation in farming research and extension systems in Latin America and the Caribbean.
94. The model was outsourced in two different ways. 1) fund management was put up for tender, which was won by the CATIE, and then 2) CATIE outsourced the delivery of extension services to private local companies, which in turn hired a series of technicians to work directly with producers. During the first two years, the fund hired 25 private companies to execute 89 projects, and provided assistance to approximately 15,500 families.

improved or gotten worse? Have the costs of extension services increased for producers?

What has happened to qualified extension agents and agronomists that are no longer working because organizations are looking to reduce their costs? There is a considerable evaluation agenda in this area.

7. 1. 7. Extension systems and farmers' links to markets

The fact that agriculture is the main source of livelihood for thousands of farming families in Central America is evident from food consumption data and market sales. The biggest challenge lies in how to jointly address increasing productivity and revenues, while also improving families' abilities to adapt to changing environmental and market conditions.

Extension systems and extension agents both face the challenge of assessing and analyzing small farmer conditions to determine if they are ready to enter a market. Not every producer is prepared to enter the same type of market, which is why different support services are required. There are many documented cases regarding the positive economic benefits from producers' link to a market. However, it has also been said that the market link is not a panacea. Green Mountain Coffee Roasters studies show that 50% of its suppliers had to withstand at least three months of seasonal food insecurity (after the harvest of 2008; Fujisaka, S., 2007 quoted by MEAS, 2014)[95]. The same study also shows that statistically, 50% of small farmers will not be able to enter a commercial market.

A possible modification or reassessment of the Central American extension systems would be to go above and beyond the traditional support generally provided to farming production. Decisions regarding any type of change should focus on deciding whether or not to increase technical support for a better understanding of supply chains as well as the opportunities, or lack thereof, for small producers to insert themselves into these chains. What type of bond is required; under what conditions could a small producer hold his place in a market; what is his current role and the potential for cooperatives?

The strength of associations continues to be of interest in discussions about the appropriate vehicle for small-scale producers. AgriLinks[96] specialists claim that the strength of associations lies in their numbers. For example, a small farmer will generally lack access to sufficient credit to make a significant investment, however, associations have a better chance of working with the banks given that the members' combined assets could eventually serve as sufficient collateral. As for extension and technical assistance, cooperatives have a better potential to pay these services and acquire bulk inputs and products in higher volumes.

The MEAS document quoted above raises a series of questions for an extension system that meets the needs of linking to a market. On the one hand, for agricultural development, it's important to evaluate if there are certain types of support for specific types of farmers to improve benefits from market access. What factors matter? On the other hand, for modern extension systems the question is whether or not they have the sufficient staff with the necessary skills to support the development of market links. How could both public and private sector actors invest in improved support for market linkage in ways that would be beneficial for the producers themselves?

95. Ferris et al. 2014 Linking Smallholder Farmers to Markets and the Implications for Extension and Advisory Services. MEAS Discussion Paper Series on Good Practices and Best Fit Approaches in Extension and Advisory Service Provision.
96. Achieving agriculture-led food security through knowledge sharing.http://agrilinks.org/events/modernizing-extension-and-advisory-services-diverse-partners-and-ict

7. 1. 8. Training and curricula to address the holistic nature of rural life, knowledge and local learning

In the last decades, a great deal of knowledge has been generated about agricultural adaptation to climate change. There is ample knowledge regarding the costs and damages from the expansion of agricultural frontiers, monoculture farming and the intensive use of external inputs. Also well known are the advantages of agro-ecological approaches that combine local and scientific knowledge. However, these learnings are generally not taught in the majority of agronomy schools in the region. The predominant form of training is one that focuses on production, which encourages a sole focus on production issues at the expense of social, environmental and market knowledge. Agroforestry, conservation farming, soil fertility management, integrated pest and nutrient management are only but a few of the agro-ecological practices which may be used by thousands of poverty-stricken farmers living under adverse conditions as strategies for local development and territorial sustainability. Omitting this type of learning makes it more difficult to adopt a multi-sectoral and multidimensional approach to extension education.

Another significant challenge lies in the gaps in education and professional training in methodologies and tools used in extension, such as adult education, which are key for integrated approaches and not just agricultural production. One of Bently & Andrews' findings in their book "Two Kinds of Knowledge" (2011) is that scientists in Central America are well-prepared to study the individual components of the production system (soil, pests, varieties, etc.) but it is hard for them to offer technological solutions in an integrated manner. They point out challenges for researchers and/or extensionists to "develop special skills" to identify famers' needs and demands. Simple, pleasant and respectful dialogue with the farmers has proven to be more appropriate than mechanical methods like diagnostics and surveys. An example of this are the special needs required to support farming families or groups of farmers seeking to organize themselves.

If governments made the necessary investments for national soil systems to generate soil maps at a plot and farm level, producers would require assistance to learn to interpret their maps and make decisions based on the information. Currently, extension systems for small-scale producers in Honduras, Nicaragua and El Salvador don't have the knowledge or the skills to perform this task. And El Salvador, which is the country closest to establishing its own soil system, must take stock of its human and technical skills to prepare for when producers demand this type of support. This investment is essential to begin changing the way agriculture occurs, moving from uninformed use of external inputs to their use in specific amounts where the soil needs them most.

The profile of the extensionist needs to change to be able to understand the multi-functional nature of agriculture, as well as to the multi- and inter-sectoral solutions to the problems facing agricultural and rural development. This is especially important with respect to climate change variability, volatility of food prices, food insecurity and poverty.

Geographical proximity and a close relationship with small-scale farmers would allow for a true understanding of producers' opportunities and needs and thereby, adapt services as needed (Myers, J)[97]. This link between extensionists and the local context in which they work, coupled with their commitment to act as change facilitators plays an educational and formative role within a development process. Ecuador and Brazil have ample experience in these long term practices (Baez, 2011)[98]. A pro-inclusive rural extension system acknowledges the

97. USAID. 2014. Webinar Recap: Modernizing Extension and Advisory Services with Diverse Partners and ICT. Nov. 21, 2014. http://agrilinks.org/events/modernizing-extension-and-advisory-services-diverse-partners-and-ict
98. RELASER and RIMISP. 2011. Rural extension with an inclusive rural development approach.

differences between rural families, highlighting the role each family member has within its economy.

Currently in the region, Guatemala leads the way with its National Rural Extension System (SNER) and its continuous education review to ensure that the territorial and national technical teams are duly skilled and update their knowledge base. The SNER prioritizes four broad subjects: a) Strategic training for rural development; b) Methodological training to strengthen extension services; c) Social economic training; and, d) Food and nutritional security training (MAGA, 2014). Training and capacity building for the human resources is provided by the Agricultural Science and Technology Institute, research institutes located at the country's numerous universities, the National Central School of Agriculture, the Agricultural Formation Schools, and the Agronomy Departments of the country's universities.

7. 1. 9. Participatory methods that seek synergies between local and scientific knowledge

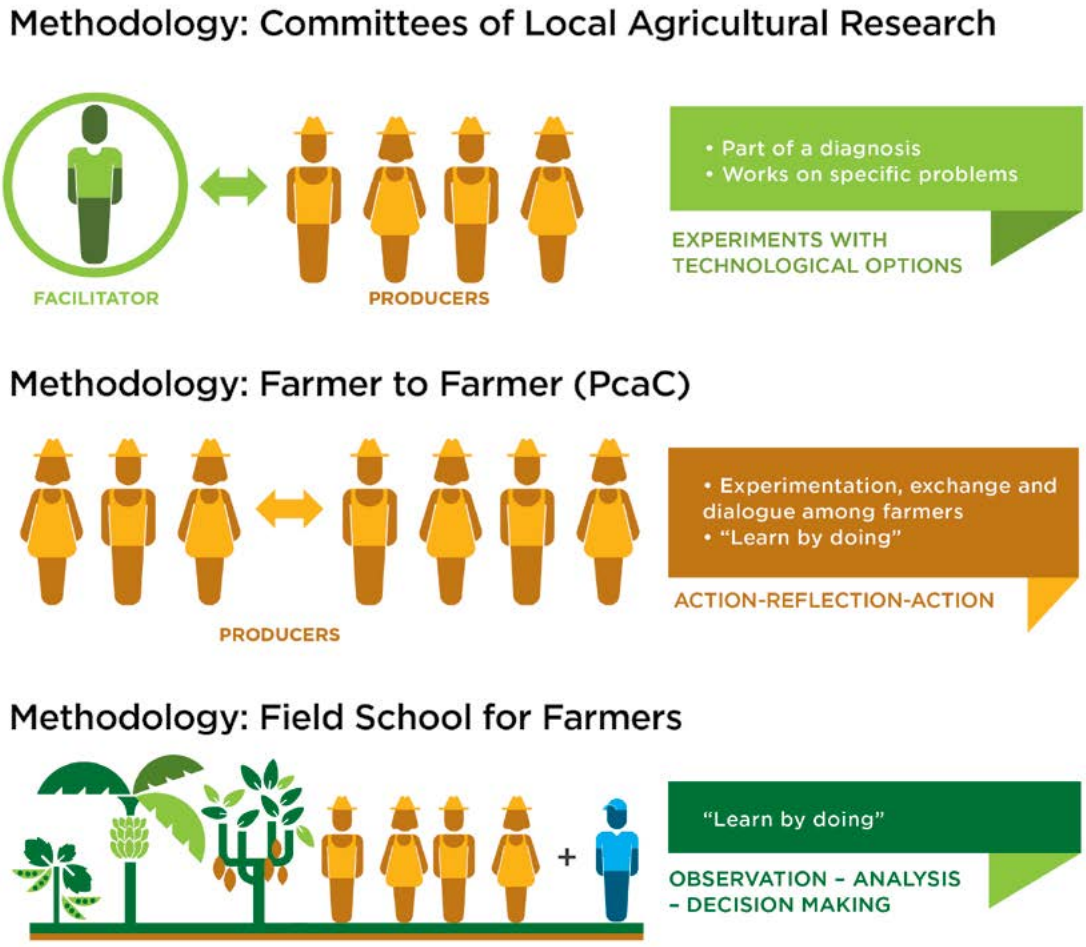
With local knowledge as a starting point, and given the complexity of rain-fed agriculture in Central America – high climate variability, degradation of ecosystems, food price volatility, and poverty, among other challenges – the extension system simply needs to overcome simply "delivering a message" and move towards a learning process with farmers. Each farm and farming family is different. They know more about their own land than any other person coming into the community and working in extension. The need is to build a more balanced teaching-learning relationship amongst farmers and extensionists, so together they can establish priorities that directly address farmers' needs.

Participatory methods which have had good results, such as the Farmer to Famer Program (Campesino a Campesino or PCAC program), have not been generally adopted. To build on this program's achievements, thought should be given to scaling up these methodologies. As an example, although the Farmer to Farmer program has provided public agencies and NGOs with an alternative approach to agriculture, its findings on strengthening farmer's knowledge within its own environment have not yet been included within national programs. PCACs may have a methodological problem given that they consider the farm and its farmer as the basic unit instead of the farming community and other stakeholders that have an impact on the landscape and watersheds where the farm is located. There are new approaches that work with producers and their families (within their own contexts) at a broader level, without which they won't attain adequate scale[99].

Field schools have been criticized for the large number of extensionists required in the field to implement their educational programs (generally 10 or more sessions per week per productive cycle), as well as other program costs and travel. They are relatively expensive, involve a great deal of work and only reach a small number of interested farmers (World Bank 2010). However, it has been proven to be a methodology with great potential for the sustainable management of natural resources.

99. National Program for the Restoration of Ecosystems and Landscapes or Programa Nacional de Restauración de Ecosistemas y Paisajes (PREP). El Salvador s Ministry of the Environment and Natural Resources. May 2012.

Figure 13. Participatory extension methodologies



7. 1. 10. Territorial extension systems, combining knowledge and local skills for rain-fed Agriculture

The local knowledge of producers – accumulated from their work with crops, soil, water and the environment – includes their familes' knowledge and develops within a specific biophysical space. However, their farms are also part of a wider landscape, where there are a series of natural (rain, runoff, erosion, pests, woods, animals, etc.) and social factors (neighbors, producer associations, nurseries, regulations, actions guided by the municipality, markets, etc) affecting them. Their community and agro-ecosystem are an intrinsic part of their potential to improve their own quality of life. Acknowledging the implications of their context – an integrated, territorial perspective – is important to revitalize rain-fed agriculture. It is precisely this social and biophysical environment which provides small-scale farmers with the majority of resources (or assets focused on livelihood) needed to to better him or herself.

By bringing the government closer to its people and their territories, it is possible to remedy faults in the design of national farming services. Decentralization[100] and the subsequent local nature of extension linked to territorial

100. Decentralization is understood as the transfer of political, administrative and fiscal authority to the lower levels of government.

research, can support a holistic agenda (World Bank, 2006) when it involves authentic decentralization that transfers not only financial resources but also the authority for decision making.

Decentralization without these elements may, in fact, limit extension services even more in terms of coverage and quality. Decentralization has a dual character. One the one hand, it refers to institutional decentralization from authorities and agencies belonging to the Ministries of Agriculture and the Environment. On the other hand, decentralization concerns not only decision making, but budgeting as well, moving resources from the central government to municipalities or associations of municipalities. One effort strengthens the other, to ensure that local authorities combine land use planning processes and risk mitigation (with respect to the growing impacts of climate change) with agricultural planning.Through a combined effort, they would be better able to include, and even accommodate, the technical assistance necessary for local farming within its biophysical, political and institutional environment.

In Guatemala, the National Rural Extension Service's (SNER) operative arm at a local level is the Municipal Extension Agency (AME). The agency receives technical support from the specialized units at the Ministry of Agriculture (MAGA) and other related bodies, for the planning, design, operation and accompaniment of processes and services provided to meet farmers' needs. SNER seeks to expand coverage and improve the efficient use of available resources through three levels of attention to producers. The first level includes specialized MAGA units, international support agencies and NGO's that work with the Rural Extension Municipal Agencies. The second level focuses on the Municipal Extension Agency and is oriented towards Voluntary Promoters. The third level focus on the Voluntary Promoters and their work with community groups.

The decentralization of extension services would allow for a better approach to climate variability, characterized by varying impacts in specific territories. According to Simpson and Burpee (2014), territory-based extension may help mitigate risks due to climate change through practices of conservation and adaption. It is important to determine the appropriate level of decentralization that would work best in ecological zones, instead of simply administrative jurisdictions – or perhaps, a solution which combines both.

In some parts of the region, there are initial steps for Municipal Environmental Units (UMA) to serve as a key local liaison to educate and introduce environmental laws for farming activities that occur within the rural territories of the municipality or federations of municipalities. [101]In the last years, a growing awareness about the need for true decentralization has been reflected in the ECADERT (Central American Strategy for Rural Territorial Development 2010-2030), among other tools[102]. The ECADERT program began in June 2010, after it was approved by heads of state and the governments of the member countries of the Central American Integration System (SICA).

The number one objective of the Central American Strategy for Rural Territorial Development 2010 - 2030 (ECADERT) is to renew, transform and strengthen the legal and institutional framework for the organization and management of rural territorial development. The strategy proposes innovation, reconstruction and strengthening of public institutions responsible for rural development within each country. These strengthened capacities will encourage better coordination and communication about territorial public policies that facilitate discussions with local stakeholders.

There are several valuable experiences in the region with varied levels of participation by the public sector

101. The National Program for the Restoration of Ecosystems and Landscapes) Programa Nacional de Restauración de Ecosistemas y Paisajes, MARN, El Salvador (2012); UMA in Guatemala.
102. Central American Strategy for Rural Territorial Development) Estrategia Centroamericana de Desarrollo Rural Territorial 2010 – 2030 (ECADERT), Central American Farming Council, Abril, 2010.

which shed light on learning about rural territorial development. In Honduras and El Salvador, there have been local efforts in remote areas103, where the presence of the central government is limited.

Municipalities have partnered and strengthened their organizational capacity for land-use planning and local management with international and local support.

From 2002 – 2009, there were important projects implemented for the promotion and strengthening of municipal associations on the border areas between Honduras and El Salvador104. And even though they focused principally on urban affairs and didn't create their own farm extension programs, they laid the foundation for the associations' integration into territorial management frameworks.

La Campa Municipality in Honduras

A new zoning scheme and participatory tax collection method was established in La Campa. The mayor set in motion an initiative for land use planning that would cover all community land, including rural areas. Tax payments would be set up in consultation with the community, via public meetings. The plan classifies each of the inhabitants by their payment capacity, land use and land quality. Land is then classified by: "land for productive use" (livestock, basic crops, coffee and forestry) or "water producing" land whose use is restricted to recreational use. New tax collection did not encounter opposition from the community and tax revenues doubled, allowing the mayor to effectively respond to local demands, giving back collected taxes in public works (roads, maintenance for schools, protection of micro basins, etc.). Through the social capital generated by this initiative, a second round of community meetings were held, and a Local Development Plan was created, approved by the Municipal Council and which became the 1999-2014 Strategic Municipal Plan. The municipality also developed other tools, approved in public meetings: a) a map delineating the municipal territory, created in coordination with neighboring municipalities; b) a map of the municipality's land use; and, c) a table of values duly defined and sanctioned by open councils held throughout the villages. Throughout this whole process, there was no intervention from the Central or Regional Government; and therefore it was a process born from the bases themselves.

Lempira Sur – Quesungual

In Lempira Sur, farming practices had caused the accelerated loss of soil fertility, increasingly poor harvests and increased vulnerability to climate change. The suitability of MRN technologies and practices depend on the local context and in Lempira Sur "practices were identified through participatory experimentation and a validation process which took two years". Through this territorial process, not only was burning discontinued, but the use of the agroforestry system called quesungual (SAQ) grew, in which basic grain crops grow under light tree cover, which provide vegetative material that acts as ground cover with crop stubble which maintains humidity and recycles nutrients. The best combination of practices for the land were identified and recommended that could be easily adopted by farming families. As a result of these changes in agricultural practices, there were improvements in yields and increased resilience when faced with droughts or extreme rain events, which are becoming more frequent given climate variability due to climate change.

Based on work cited by PRISMA, there are three levels of collective action that bring together community networks, municipal governments, some central government institutions and the NGOs:

1. The local level with community groups that participate in initiatives for soil protection and restoration by adopting the Quesungual system at a farm level, with various farms within the same territory.
2. A second level of community cooperation through networks that form to address environmental vulnerabilities, and which serve as a platform for self-managed local development; for example, focused on managing watersheds which provide water to the municipalities.
3. And a third level, which widens the level influence of territories; for example, associations of municipalities.

103. Honduras: Lempira Sur, La Campa, Opalaca, Oportoro/El Salvador: Cayaguanca, La Montañona, North-Eastern Morazan.
104. The project "Programa de Desarrollo Binacional en las Zonas Fronterizas Terrestres de Honduras y El Salvador", (Binational Development Program in Land Border Areas between Honduras and El Salvador) Twenty second Quarterly Technical-Financial Report, July-September.

Case study of La Montañona in El Salvador

In La Montañona, there were important advances in reaching a social consensus on ecological restoration. Previous attempts had been made to reverse the degradation of natural resources caused by farming and cattle ranching in hillsides through reforestation and soil and water conservation in farms. Nevertheless, erosion worsened through practices such as burning for planting preparation, deforestation and the use of pesticides. Landslides occurred and surface and groundwater suffered. During the 1990s, organizations and NGOs began to promote productive systems such as ground cover management, pesticide replacement and productive diversification for soil and agro-ecosystem protection and restoration. An association was established between seven municipalities, which resulted in a joint Technical Unit, that to this day has its own technical assistance system.

Although no new research was conducted for this paper, of the four countries in the region (CA-4), Guatemala is the country with the most experience working at a large scale. It is the leading country in the region, and also where the most participation from the public sector in coordination with international cooperation has taken place. After many years of experimenting with different models for extension services or local technical assistance through international cooperation projects and local programs, Guatemala has created what is known as Municipal Farming Technical Units (UTAM). Currently, Guatemala is designing a strategy to conduct a series of investments and institutional reforms for extension systems, and mean to reactivate and invigorate the National Rural Extension System (SNER). According to MAGA, the SNER would be its main tool to implement the Ministry's policies and programs in the rural areas (National Policy for Comprehensive Rural Development) and the Family Farming Program to Strengthen Farming Economies 2012-2015, the Zero Hunger Pact and the National Farming Policy 2012-2027.

The goal is for MAGA to have national coverage, with extension agents and community promoters located in the 334 municipalities in the country, through operational municipal offices of the SNER.[105] This system would incorporate learning from previous experiences, maximizing the relationship between local technicians and community promoters to expand coverage. An interesting aspect of the proposal is that the central government considers it a coordinated territorial effort working through Development Councils (local, departmental, regional) which are themselves decentralized entities within the country's municipalities as well as mechanisms to guarantee citizen participation within local planning processes[106]. There is a mandate to collaborate with local authorities who interact with extensionists in the territory[107].

Community Association La Mancuerna

There is another example of decentralization in Guatemala among 8 cooperating municipalities, MANCUERNA, that created policies and territorial projects for Integrated Water Resources Management. All 8 municipalities are located in the upper watershed of the Naranjo river in western Guatemala. Five belong to the San Marcos Department, while 3 belong to the Department of Quetzaltenango. The municipal association prepared its own Territorial Strategy Plan of MANCUERNA for the 2008-2009 period, with the mayors' commitment to work in the various commissions of the association. In 8 years work, they created a monitoring and evaluation system; a diagnosis and strengthening plan for each municipality and the management plans for 4 micro-watersheds;and a georeferenced information system, SIG and PET (Estuardo, 2011)[108].

To guarantee the sustainability of the MANCUERNA association, an inter-municipal team is kept active. Each municipality provides an annual fee as well as a percentage of each project managed by the Association.The relationship between local authorities and municipal technicians with other local or national civil entities working within the area and involved with farming activities is also very important. This includes the local development committees, farmers associations, women's associations, national NGOs, universities, etc. This level of coordination is an issue that requires deep discussion and was not part of this research.

105. MAGA, Programa de Agricultura Familiar para el Fortalecimiento de la Economía Campesina (PAFFEC 2012-2016) MAGA: Documento de Política Pública No. 2.
106. Proposal by SEGPLAN or Secretaria de Planificación y Programación de la Presidencia (Presidencys Secretariat for Planning and Programming).
107. Leadership over the SNER service befalls on the Directorate for Regional Coordination and Rural Extension. Through this instance, the service is structured and guidelines are set with the following levels: the Sub-directorate of Rural Extension, MAGA's Departmental coordination and Municipal Extension Agencies (agencies made up of a university professional and two mid-level technicians). In 2013, MAGA's human resource was made up of a total of 1,413 jobs, distributed amongst permanent staff, temporary staff and daily-paid-workers. ICTA's human resource is made up of 68 professionals which perform research and technology transfer functions, and of which 100% of them are permanent staff.
108. Estuardo, Rene. 2011. Municipal experiences with GIRH: Municipality Association of the Naranjo River basin (MANCUERNA), Guatemala. Global Water Partnership Central America.

As far as experiences with international NGOs, Catholic Relief Services (CRS) has its own ideas and conclusions, based on its own experience with different extension models within its regional project, Agriculture for Basic Needs (A4N). CRS's first conclusion is that the local extension model using community promoters is a highly efficient mechanism for the participatory generation of knowledge with a large number of communities and families. The second reflection verifies that good relations among partner organizations and local governments facilitates establishing efficient cooperation mechanisms with the municipalities which may serve as models for a permanent support structure for the communities[109].

After more than 20 years since the beginning of the structural adjustment programs in Central America and with extension models dating to the green revolution, there is a need to promote meaningful changes to face the effects of high climate variability in the region and the food price crisis. The challenge lies in the coordination among Ministries and other government agencies working in the same territory. Clearly, this is a multi-sectoral agenda that involves issues which go beyond just farming production and which include food security, soil restoration and agro-ecosystems, health, human and animal nutrition, pasture and forage management, physical infrastructure, exchange and trade, as well as natural disaster management.

In this day and age, the scale of land use for farming throughout the region is huge. The impacts of bad agricultural practices on other sectors is likewise huge. Investments are high in rebuilding damaged infrastructure (bridges, destroyed roads, reservoir and irrigation system sedimentation, dredging for rivers and ports, etc). Investing in the reactivation of farming is necessary, particularly on hillsides, and focusing more in the holistic management of soil-water-plants that can deepen the knowledge base of farmers, their families and their communities.

For rain-fed agriculture in our region, GWI proposes converting previously considered climate weaknesses into opportunities. Research is necessary to harmonize scientific knowledge with local cultural know-how. For example, if the scientific world's ability to forecast weather was made available to farmers in every-day language, this would contribute to adaptation actions. Overall, farming which relies more on knowledge would be an agriculture capable of capitalizing on these conditions as opportunities.

Agriculture based on knowledge would however require a significant investment from amongst the different collaborating agencies. Ideally, this would include not only local assistance by small technical units within the municipalities or municipal associations, but also an improvement of overall rural education where a small producer, as well as his wife and children, may be trained in information services systems based on new technologies (for example, digital soil maps, meteorological reports, micro-organism reproduction systems, local or municipal production of compost fertilizers, etc.).

Without a doubt, it is difficult to calculate the costs of a model based mostly on knowledge, one more interactive between technicians or scientists and the producers, their families and their environment. In fact, as we've mentioned it this document, there is not good data for a cost analysis of the different extension models that exist. Moreover, there is a lack of understanding of the universe of producers and existing extension coverage among all productive projects in the field (public, NGO and private). Being able to provide services to a significant portion of the small-scale farmers through a public extension system will be a highly expensive effort, but it will also be incredibly valuable.

In line with the reforms suggested by the IAASTD within the CCTA system, it is important to integrate excluded sectors through: access to information and strengthening capacity and decision-making abilities. There are several case studies which recommend the decentralization of the extension model, a horizontal focus, producer

109. Evaluation of the Implementation Strategies and the Sustainability of the Promotor-based Extension Model of the Project "Agriculture for Basic Necessities" (A4N), Catholic Relief Services – USCCB, Henreaux, J., R. Muschler, J. Faustino, agosto de 2012.

leadership, off-farm job opportunities and market orientation. This is a more holistic way of viewing the rural world in which the concept of knowledge management goes beyond the adoption of technology and innovation. The OECD places knowledge-based agriculture at the epicenter of a multi-faceted innovation system where the "extension agent may be both a knowledge intermediary as well as an information facilitator for the farmer".

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