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New Agricultural Innovation Systems and Smallholder Participation in Modern Farm Product Markets

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ABSTRACT

Smallholder farmers will continue to play a critical role in meeting the growing demand for food and non-food farm products in the next 30 years. Challenges in meeting this demand include climate change; deficiencies in enabling environments, resources, and capacities; and inappropriate institutional models of RD&E and development. Smallholders must improve productivity, volume, quality, and consistency of supply, but their downstream customers must also be competitive. Most smallholder supply chains lack the capacity for this. Therefore, new, vibrant agricultural innovation systems, or AIS, and improved enabling environments are vital. This paper outlines a transdisciplinary framework for investigating and facilitating these changes. It is based on the literature, projects, and experiences working in a range of developed and developing countries. A dualistic agribusiness systems model can help identify the complexity of problems, and the constraints to improving the productivity of smallholders and their value chains. It combines participatory and pluralistic action research and action learning processes to provide relevant solutions to improving the competitiveness of these chains. Key extension functions of rural advisory services to accelerate scaling out are integrated and discussed. The focus is at the program level, but it could be scaled to the macro level. Nevertheless, incorporating such approaches requires changes in philosophy, practice, and commitment of those involved in developing the agribusiness sector.

Keywords: agribusiness development, agribusiness systems, dualistic model, action research, action learning, extension

JEL Classification: 001, 013, 016, 030, 053

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INTRODUCTION

Enabling smallholder farmers to participate successfully in the modern globalized food and non-food farm product industries will be critical to meeting emerging demands. However, the traditional systems of research, education, and extension are unable to achieve the level of innovation required and new institutions and strategies are needed (World Bank 2012). Meeting the increasing demand for food relies on improvements in productivity, which in turn relies on innovation. In this context, agricultural innovation “is the process by which individuals or organizations master and implement the design and production of [agricultural] goods and services that are new to them, irrespective of whether they are new to their competitors, their country or the world” (Rajalahti 2012, 2). The conceptual framework of an agricultural innovation system (AIS) has been proposed, which is defined as “a network of organizations, enterprises, and individuals focused on bringing new products, new processes, and new forms of organization into economic use, together with the institutions and policies that affect their behavior and performance” (Rajalahti 2012, 2). The purpose of this paper is to outline a transdisciplinary framework for agribusiness development that is consistent with the need to develop new AISs and could contribute to their development. Initially, the factors constraining the participation of smallholder farmers are outlined. The framework that follows emphasizes multidisciplinary and transdisciplinary research, development, and extension (RD&E) using a dualistic agribusiness systems model to guide the processes. It also incorporates pluralistic and participatory action research and action learning methods focusing on groups of smallholder farmers and their supply and value chains. Finally, it illustrates a model for scaling out based on integrating five key extension functions.

Critical Role for Smallholder Farmers and Their Supply Chains

The world will have a population of about 9.7 billion people by 2050, with demand for food expected to increase by 60 percent up to 100 percent over that time (Elferink and Schierhorn 2016). An additional concern is that declines in undernourishment have plateaued, while the number of people suffering from hunger has been slowly increasing (FAO et al. 2019). It is estimated that around two billion people, or about one-quarter of the world’s population, are food insecure in that they do not have regular access to sufficient, safe, and nutritious food.

Production and productivity must increase to meet this demand. The three main options for increasing production are expansion of land, increases in inputs (including irrigation), and increases in factor productivity (USDA 2017). While expansion in land and irrigation was a source of growth in previous decades, more recently, the rate of growth in resources used for agriculture has declined, except in lower income countries, with most of the growth in the past two decades coming from increases in productivity.

Much of the world’s population is in the developing world (or countries with below average income) and most population increases will occur in these countries (FAO 2009). In developing countries, smallholder farmers provide around 80 percent of the food consumed (IFAD 2013). When combined with the resource constraints to production increases in the developed world, it becomes apparent that smallholder farmers and their supply chains in developing countries will need to provide a large proportion of the increased demand for food required by 2050.

As much of the poverty, poor nutrition, and food insecurity is concentrated in countries where agriculture is a large component of the economy and is dominated by smallholder farmers, economic development of the agricultural sector can reduce poverty and improve nutritional outcomes (Hazell et al. 2006; IFAD 2013). As IFAD (2013, 11) suggests, the importance of smallholder farmers “as food producers and the fact that they comprise such a large proportion of

the world's poor indicate that their development significantly helps reduce poverty and hunger.” There is strong evidence that in these countries improvements in agricultural productivity have been more important than improvements in other sectors in reducing poverty and improving human nutrition. However, increases in farm productivity are intimately linked to the productivity of their value chains, so that improvements at the upstream and downstream levels are also important (Ferris et al. 2006).

Food losses (from postharvest up to retail) are of particular concern in developing countries and their smallholder chains, which FAO has estimated using a Food Loss Index (FLI) to be 14 percent by value of food produced globally (FAO et al. 2019). However, the percentage losses vary widely by region and commodity group, e.g., from 5–6 percent to 20–21 percent in different regions, and from less than 10 percent for cereals, and over 20 percent for fruits and vegetables, and for roots, tubers, and oil-bearing crops. Less reliable information is available on food waste, which covers retail and consumption losses, but these can also be high for perishable products. Decreasing losses and waste can improve food security, nutrition, and lessen negative impacts of agriculture on the environment.

Increasing Smallholder Supply to Meet Demand

In the period from 2001–2014, global agricultural output increased at an average annual growth rate of 2.5 percent (USDA 2017). However, much of this increase was due to increases in lower income countries (3.8%), lower middle-income countries (3.5%) and upper middle-income countries (3.2%), with the growth rate in high income countries being only 0.7 percent. Increases in lower income countries have mostly been due to increased use of resources, rather than increases in productivity as it was for most other country categories. Unfortunately, increased land clearing and resource use have negative externalities for the environment, which must be addressed (World Bank 2007; Godfray et al. 2010).

Facilitating improvements in smallholder supply in the next decades to improve food security and nutrition, while improving sustainability, will not be easy. An assortment of constraints must be overcome. These include: changing markets (UN DESA 2017); small size of farms and their production (Hazell et al. 2006); lack of investment in agricultural productivity (OECD and FAO 2012; Ferris et al. 2006; UN DESA 2011); lack of finance to invest in change (Godfray et al. 2010); poor transport, market, and storage infrastructure (FAO 2017; Godfray et al. 2010); difficulties meeting requirements of modern value chains (FAO 2017; Da Silva and Rankin 2013; World Bank 2007); environmental impacts (FAO 2009; UN DESA 2011); climate change (UN DESA 2017); deficiencies in agribusiness enabling environments (FAO 2013a; UNIDO and GTZ 2008); lack of understanding and incentive for research institutions and agribusiness to focus on smallholder needs (FAO 2017; Viatte et al. 2009; World Bank 2007); and inappropriate models of RD&E (Rajalahti 2012).

Much of this increase in supply will have to come from increased productivity through the use of new technologies and improvements in management and efficiency (USDA 2017), with FAO (2009) suggesting 80 percent of the increase will have to come from growth in yield and cropping intensity. However, improved integration, management, and efficiency of smallholder value chains will be important drivers for improvements in farm and chain productivity (FAO 2013c; FAO 2019; Shepherd 2007; Godfray et al. 2010) and in reducing the environmental footprint of agriculture (FAO 2016).

Need for Structural Transformation

The World Economic and Social Survey for 2017 (UN DESA 2017) reviewed 70 years of its publication, and concluded that one of the important lessons of development is the need for structural transformation. What they meant by this is a fundamental change in objectives and policies resulting in the large-scale transfer of resources between sectors in the economy. Their key conclusion that successful development

requires the integration of all relevant dimensions is also pertinent to the sub-sector of agribusiness. Indeed, they use the agricultural sector as an example when they say that successful agricultural development “would entail dealing simultaneously with agricultural research and extension services, seed and fertilizer delivery systems, marketing and transportation, and access to finance, so as to reduce the traditional constraints faced by smallholder agriculture” (UN DESA 2017, 93).

In essence, this approach reflects the principles inherent in the AIS concept: traditional agricultural knowledge and information systems integrated with bridging and coordinating organizations that facilitate partnerships and interaction with actors in the system, such as producer organizations, input suppliers, exporters, and consumers (Rajalahti 2012). It also involves ensuring that government agricultural policy, regulatory frameworks, informal institutions, and practices, behaviors, and attitudes support the process of innovation.

Andre et al. (2018) suggests that the AIS approach involves a co-evolutionary process, involving partnerships and multi-stakeholder initiatives and that narrowly focused interventions, such as those focusing on productivity improvements or value chain developments, will have limited benefits for smallholder agriculture. They call for partnership approaches that facilitate commercial, technical, and institutional innovation because of their synergistic effects that will lead to greater, lasting impacts. They also propose that interventions should be adapted to fit the local context and targeted for specific groups.

While changes involving structural transformation and co-evolutionary processes are likely to produce better outcomes, they are more complex and will take time for results to emerge. The observed experience is that success required commitment for over a decade or more from government, donors, international organizations, and national partners (Andre et al. 2018).

AN INTEGRATIVE FRAMEWORK

A key aim of this paper is to provide a framework for integrating all the relevant dimensions of agribusiness systems when designing and implementing development projects. Conceptually, the approach to be outlined can be used at a national, industry, or project level; however, the discussion will be most relevant to program or project level interventions. Since the focus is on practical approaches to increasing smallholder participation in world farm product markets that addresses the constraints to their involvement, a framework for conducting RD&E is developed, which builds on the concept of an agribusiness system.

In developing countries, most smallholder farmers supply local traditional markets. Therefore, their chains are described as “resource poor”, whereas, chains that supply the higher-priced institutional markets are “resource rich”. To help understand the implications of this dichotomy for conducting RD&E, the concept of a dualistic agribusiness system is introduced. Next, a methodology is described for RD&E to take an AIS approach that involves a co-evolutionary process to involve smallholder farmers in multi-stakeholder partnerships that will lead to efficiency and effectiveness improvements in their value chains. This involves combining participatory and pluralistic action research and action learning processes with smallholder farmers and actors in their agribusiness system. Finally, some principles are discussed for integrating R&D with the E of rural advisory services, which is necessary for scaling out.

Smallholder Agribusiness Systems

Following Davis and Goldberg (1957), an agribusiness system is the set of interacting organizations that jointly provide food and fiber for consumers, including the organizations that produce, process, or distribute food and fiber products, and the organizations that provide inputs to the system. Davis and Goldberg (1957, 74) were early proponents of the need to take a holistic

approach to addressing development issues in the agribusiness system when they said:

“the problems of commercial agriculture...need to be approached as agribusiness issues because both their cause and their solution encompass the off-farm functions of supply manufacturing and processing-distribution as well as on-farm production.” The point is that the approach to solutions must be as comprehensive as is the bases of the problems themselves (original italics).

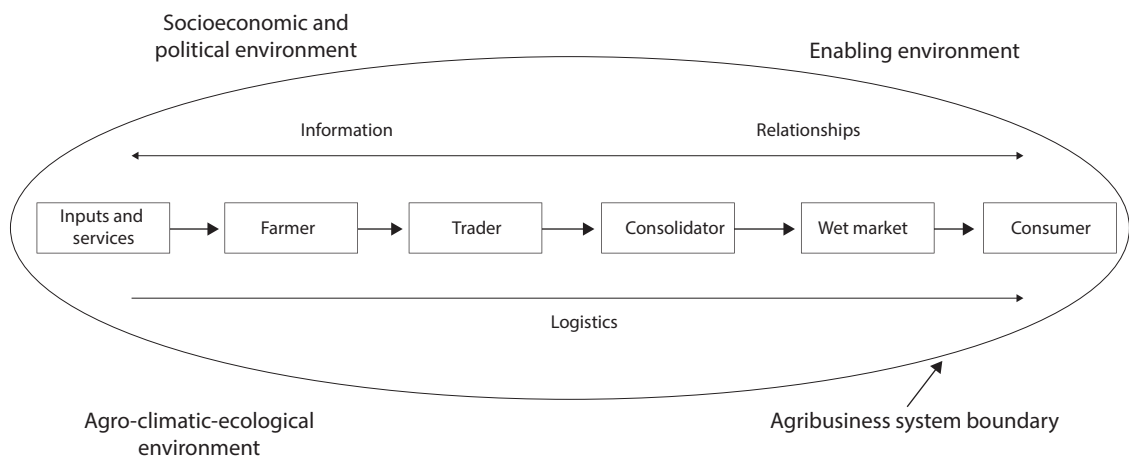
Their comments are consistent with UN DESA (2011, 83) that “all actors, institutions and processes, within the whole food chain must be part of the policy innovation framework.” As is recognized in [UN DESA \(2017\)](#), structural transformation is an acknowledgement that the food and fiber system is an open agribusiness system that interacts with its environment and we need to understand the components and their relationship in the system ([Von Bertalanffy 1968](#); [Checkland 1981](#)).

A simple conceptual model of an agribusiness system provides a framework for beginning the investigation for an intervention. This is illustrated in Figure 1 for smallholder vegetable farmers in

Southeast Asia delivering to local wet markets. For simplicity, the system boundary in this case is defined by the actors and functions associated with the value chain for one or more goods. The suprasystem incorporates the agro-climatic-ecological environment, which incorporates the natural capital and its interactions with natural and human-induced changes in the environment. It also includes the socioeconomic and political environment, which we define to include the other capitals (produced economic, human, financial, and social). This overlaps with the enabling environment, with a conducive enabling environment for agribusiness defined as one where the “sets of policies, institutions, support services, and other conditions that collectively improve or create a general business setting where [agribusiness] enterprises and business activities can start, develop and thrive” ([FAO 2013a, 5](#)).

While each supply chain is different, there are elements that are often consistent in a smallholder chain. The key actors are the suppliers of inputs and services, farmers, traders/consolidators, wholesalers/retailers in wet markets, and consumers. There can be additional actors such as processors or supermarkets. Because of the many links in the chain and the often adversarial nature of the relationships, information flows are poor, leading to limited understanding of market requirements and demand by smallholder farmers

Figure 1: Simple conceptual model of an agribusiness system



Adapted from: [Murray-Prior et al. \(2004\)](#)

(Murray-Prior et al. 2014). Because of small quantities, the many hands that the product passes through, and inefficient and inferior production, packaging, handling, logistic, and marketing systems, quality tends to be poor and inconsistent. Most farmers are unaware of the premiums that exist for better quality products, although there is little opportunity for them to receive a higher price even if they were able to produce a premium product at the farm gate.

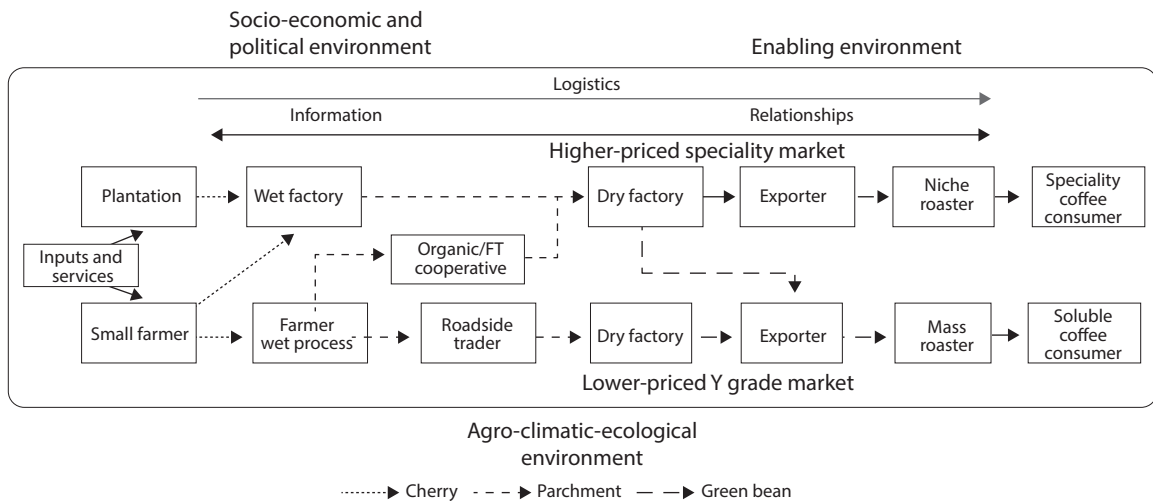
Dualistic Agribusiness Systems

Since most smallholder farmers are unable to access the increasingly globalized food and fiber industry, there are two types of food chains in many countries: “resource poor” chains that supply traditional markets and “resource rich” chains that supply the large institutional buyers. This is conceptually similar to the theoretical model of a dual economy described by Lewis (1954), who distinguished between a low productivity, labor intensive agricultural sector, and a smaller, higher productivity manufacturing sector established by foreign colonial powers. Murray-Prior and Ncukana (2000) adapted this idea to reflect the reality of issues arising for development of dual agricultural chains in South Africa, with the concept of dualistic agribusiness systems. This was later adapted to aid investigations of similar issues

in food chains of the Philippines (for example, Murray-Prior et al. 2004) and other post-colonial, developing countries (for example, Murray-Prior et al. 2008).

The case of the dualistic Arabica coffee industry in Papua New Guinea is illustrated in Figure 2. This dualism arises from its colonial history, where coffee plantations, with mainly white colonial owners, were developed on land expropriated from indigenous owners, while alongside them, smallholder indigenous farmers developed their own coffee gardens. While the size of the plantation sector has declined since independence, the remaining plantations produce and sell to the specialty coffee market at higher prices, while the smallholder coffee growers sell to the soluble coffee market (Murray-Prior and Batt 2007). The plantation coffee is processed in large wet mills, with exacting quality standards, and is kept separate along the chain. It sells at a premium to the ICE Futures Other Mild Arabicas or Coffee C contract. Conversely, smallholder coffee is processed in small quantities, using rudimentary wet processing techniques, and is therefore of variable quality and has other defects in taste and presentation. Accordingly, it is sold at a discount to Coffee C and most smallholder coffee ends up as soluble coffee. However, some of the coffee sold by plantations is made from cherry purchased

Figure 2: Dualistic systems model of the PNG coffee industry



Adapted from: Murray-Prior et al. (2008)

from smallholders, processed through their factories, and ends up as specialty coffee. Indeed, it can be argued that most of the highland Arabica produced in PNG could be sold as specialty coffee if the constraints in the smallholder supply chain could be overcome.

A dualistic agribusiness systems framework therefore can help in the process of analyzing, identifying, and understanding the binding constraints faced by smallholder farmers in accessing the emerging higher quality and higher priced markets and identifying research and development priorities and changes to the chain and to the enabling environment that will enable them to do so (for examples, see [Murray-Prior et al. 2004](#) and [Murray-Prior 2007](#)).

PLURALISTIC AND PARTICIPATORY ACTION RESEARCH AND ACTION LEARNING

This section outlines a process for conducting research and development investigations that incorporates pluralistic and participatory action learning and action research processes. As will become obvious, because of the complexity of the systems being examined, a transdisciplinary AIS process is required. [Cundill, Roux, and Parker \(2015\)](#) suggest that transdisciplinarity incorporates “mutual learning and collaboration among diverse stakeholders, i.e., scientists, citizens, policymakers, and resource managers.” In the context of development for an agribusiness system, this would involve a team involving farmers, researchers, rural advisory services, government decision- and policymakers, and key actors in the chain.

Pluralism in Research and Development

Given the complexity and range of issues to be addressed, no single research paradigm or discipline will be sufficient to provide the appropriate understandings or solutions ([McGregor, Rola-Rubzen, and Murray-Prior 2001](#)). That article describes a pluralistic systems approach as one where “appropriate methodologies are chosen to suit the problem and a consequent diverse range of methods and techniques are used in the analysis” (p. 64). This is a development of

principles proposed for research in management science by Jackson (1999), which in turn was a development of approaches proposed by others (e.g., [Jackson and Keys 1984](#); [Gregory 1996](#); [Mingers and Brocklesby 1996](#)). Jackson (1999, 20) argues that the best results can be obtained when researchers use a system of systems methodologies:

methodologies premised upon alternative paradigms together..., also encourages the combined use of diverse methods, models, tools and techniques in a theoretically informed way, to ensure maximum flexibility in an intervention.

He suggests using a soft-systems framework as a starting point for examining complex systems, although more recently, he has critiqued a wider variety of “problem structuring methods” such as “strategic options development and analysis” and other approaches to dealing with complex systems ([Jackson 2006](#)). A soft-systems process allows for a plurality of worldviews and incorporates a learning process by means of which those involved can learn about possible solutions from those with different worldviews. Nevertheless, complex systems are turbulent, messy, wicked, and varied ([Jackson 2006](#)) and, therefore, require pluralistic approaches and a rich variety of methodologies to analyze.

The value of using a soft-systems approach at the start of the analytical process (e.g. [Checkland 1999](#)) is that unlike hard systems approaches, it does not assume that the observers or researchers have a clear picture of the system ([Murray-Prior et al. 2004](#)). The goal is to obtain a clearer understanding of the elements of the system and the system boundaries and problems to be addressed, without assuming which paradigms or theories will be appropriate to address the problems. A range of mainly qualitative techniques can be used to develop understanding of the system, with the information gathered used to develop rich pictures of the system and to identify problems to be addressed.

Problem identification is a subjective process, influenced by relationships in the research team. However, the aim of a soft-systems process is to reach a level of accommodation or consensus about the problems or issues to be addressed. Part of this will involve identifying which of the problems are most likely to be limiting the ability of the chain to improve its competitiveness, efficiency, and profitability and to analyze or address these first. Some of these will require research, while others will require processes to change behaviors or policies using existing knowledge. Some of these changes will be required of chain actors, while others may require changes in the enabling environment.

The choice of methodologies used to analyze the problems identified is then guided by the problems to be addressed, with no one worldview or paradigm dominating the analysis (Murray-Prior et al. 2004). Hard systems, soft systems and other systems methodologies may be used to analyze the subsystems and problems. This is consistent with the learning cycle of soft systems (Checkland and Scholes 1990), but it does not imply that the methods, models, and techniques are separated from their theoretical foundations. Indeed, each research investigation that addresses one or more of the identified problems should be conducted consistent with its theory, assumptions, methods, research questions, or hypotheses so that they can be published within their discipline and add to the body of knowledge (Murray-Prior et al. 2004).

The value of a pluralistic research and development framework, when combined with the agribusiness systems model, is that they provide a clearer picture of the system boundaries, the actors in the chain and their relationships, the institutional frameworks relevant to the enabling environment and the key constraints. It integrates disciplines within a research process, while maintaining discipline integrity, but allows discipline-based solutions to be challenged by other disciplines or adapted using findings from multiple disciplines. Some researchers and stakeholders may find this confrontational because the solutions suggested by different paradigms may be contradictory, but this

may be important as it suggests need for caution and perhaps further investigation. It also forces participants to question their implicit and explicit assumptions and relevance of their worldview and findings. Therefore, there is potential to improve theory.

A methodological approach to conducting pluralistic research was expounded by Murray-Prior et al. (2004) that included a series of steps: (1) analyze the situation with stakeholders using a soft-systems approach; (2) structure problems and develop ideas for “relevant” systems models; (3) conduct research on problems using disciplinary methodologies and suggest improvements; (4) compare and debate the results of the models with the real world (in conjunction with key stakeholders); (5) identify desirable and culturally feasible changes; and (6) take action to improve the situation. As part of this process, a series of investigations was conducted using a range of methodologies. Qualitative methodologies were used to gain initial insights, followed by quantitative surveys that combined data collection for four different methodologies. Initially, the data was analyzed descriptively, while researchers extracted the quantitative data required for their methodology, analyzed it according to theory, and identified conclusions and recommendations. These were then compared, debated, and combined into project recommendations.

Participatory Processes

Government and other development funding agencies often demand the use of participatory processes, even though the criteria and procedures required to obtain the funding can mean that the term is used ritualistically. Participation can mean different things to different people. Arnstein (1969) was one of the first to address this issue when she developed her typology of citizen participation. It has a ladder of participation with eight rungs, starting with rungs of nonparticipation, followed by rungs three to five of degrees of tokenism, to the final three rungs of partnership, delegated power and citizen power. Another typology developed by Pretty (1995) has seven levels, with the top three levels of participation (functional, interactive, and

self-mobilization) being similar in characteristics to the top three in Arnstein's typology.

Both authors acknowledge that the highest levels of participation are not always possible with the poor (or smallholder farmers) because of their context. It also depends on the problem to be addressed as some higher-level research and enabling environment issues will be perceived of little immediate relevance or interest by smallholder farmers. However, participatory projects should not involve participation below the partnership or functional levels, at the very least. For example, research on farmers' fields, where farmers are not involved in experimental design or the process of learning from the results but simply receive material incentives to participate, does not meet this criterion and is placed at level five in Pretty's typology (Pretty 1995).

Consequently, there is a spectrum of increasing degrees of participant power. Sometimes, smallholder farmers may be involved with a project at partnership or functional levels, but over time may move to higher levels of control and even become self-mobilizing. Also, communities are not homogenous, and nor are their views; powerful, articulate, and organized people and groups may dominate proceedings (Prior 2013). He suggests that those proposing participatory processes should be clear about the goal and purpose of the processes throughout their various phases when engaging the communities, and what level of involvement they will have in decision making.

Action Learning Versus Action Research

Jennings (2005) argues that it is important to distinguish between action learning and action research because the terms are now widely used in development work, although some development workers seem to use the terms interchangeably, creating confusion, dissatisfaction, lack of confidence, and even criticism of the processes. Murray-Prior et al. (2013, 270) argue that when conducting interventions in agribusiness systems, "action learning and action research processes can help integrate research, development, and

extension for supply chains, but there has to be clarity about their meaning and use if they are to be effective."

Learning is defined by Kolb (1984) as the creation of knowledge "through the transformation of experience." His experiential learning cycle has four steps: planning, acting, reflecting, and cementing, and involves a sequence of cycles or trials, with each cycle extending and enhancing the ideas based on the learnings from the previous cycle. These processes are assumed to occur with a group or team of people.

Research is also a cyclical (or helical) process, which includes many of the same steps as the Kolb cycle. The main difference between learning and research is, with research, "we intentionally set out to enhance our understanding of a phenomenon and expect to communicate what we discover to the larger scientific community" (Leedy and Ormond 2001, 4). Scientific research involves investigations using the scientific method, which must be published in scientific literature and can be overturned or rejected if the evidence does not convince the scientific community. Conversely, learning does not necessarily require either of these activities. However, we need to recognize that there is no one scientific method, and no one methodology (Caldwell 1991; McCloskey 1983), and there could be a pluralism of methodologies, as discussed earlier.

Similarly, there is no one approach to action research, as is acknowledged by Coghlan and Brydon-Miller (2014) who solved the problem by defining action research as "a term that is used to describe a global family of related approaches that integrate theory and *action* with the goal of addressing important organizational, community and social issues together with those who experience them" (p. xxv, original italics). As Stringer (1996) suggests, it involves a problem to be investigated, a process of enquiry, explanations that provide understanding of the problem, and actions that attempt to overcome the problem. Perhaps a difference between action research and many research projects is provided by a quote from a colleague of Stringer (1996, 11, original italics)

who said “the difference with your work is that you *expect* something to *actually* happen as a result of your activities.”

Action learning involves a group or community involved in learning with their fellow members about how to improve their lot based on reflections on their experiences and implementing solutions based on this process. While this occurs in a group, participants manage their own activities and learning and can draw separate learnings from their personal experiences. This can occur with or without a research process (Murray-Prior et al. 2013). However, action research involves a team of researchers (which may include community members), conducting scientific research with and alongside a community. They draw collective learning from collective experience and validate it through peer review. Because the community is involved in this process, they are likely to incorporate the learnings of the researchers in their own action learning process.

Integrated Participatory Action Learning and Research

When dealing with agribusiness systems, farmers and chain actors have the key role in the action learning process, whereas, researchers have the key role for the action research processes. However, in an integrated participatory action learning and participatory action research process, all actors can contribute to both processes. While the processes are conceptually separate, there is considerable overlap. For instance, researchers will receive and give feedback from farmer group or chain activities, while farmers and chain actors will receive information on research outcomes, sometimes as part of the same meeting.

Action learning for smallholder farm value chains

The eight-step cluster marketing process for agroenterprise development (CRS-Philippines 2007) is an example of an action learning process, which, while primarily focused on marketing, provides an opportunity to integrate issues arising throughout smallholder supply or value chains. Farmers are taken through a series of steps, some

of which include action learning cycles (for example, the test marketing step). It begins with site selection and building partnerships with local businesses (including finance and other inputs) and markets, local government, and NGOs to form a working group to start the cluster orientation of farmers. This is followed by participatory processes in which farmers decide on the products that will be the focus of their cluster group, then conduct a market chain study and begin negotiations with potential buyers. The cluster then begins the process of formation and formulation of a plan to plant, harvest, and market the chosen products. This is where sourcing input supplies and production information become important. The test marketing step involves at least four trial product deliveries and farmers have an opportunity to assess performance and learn how to produce a product that meets their customers' requirements. Following the test marketings, the cluster then plans to scale-up production and assesses the potential to market additional products. Finally, a cluster strengthening process is undertaken.

The cluster marketing process was evaluated as part of an Australian Centre for International Agricultural Research project in Mindanao in southern Philippines (Rola-Rubzen et al. 2013). It found that the 29 vegetable marketing clusters and 360 farmers covered by the study had increases in household income over non-cluster farmers due to increases in the range, volume, and price of most vegetables. Equally important was that the members had increased their negotiating skills; bargaining power; quality and yields of produce; and access to government, NGO, and private sector services.

As part of the evaluation of the CRS process, Murray-Prior et al. (2013) addressed the issues of fostering resilience in clusters so they can survive with minimal support and suggested incorporating an exit strategy for the donor agency that facilitates the clustering process. They suggested a three-phase process: establishment phase, building resilience phase, and an exit or graduation phase (i.e., graduation for the group and exit for the donor).

Participatory action research and learning combined

Working with farmer groups, such as cluster marketing groups and their associated chains, provides an ideal opportunity to conduct participatory action research. The advantage of this approach is that the pluralistic research process outlined earlier can be used to identify and address issues relevant to the agribusiness systems associated with the chains. Any solutions identified through this process can be tested with the farmers and chain actors, and can be developed so that the delay between the research and adoption of the findings is minimized.

As part of the research process, farmers and chain actors can be involved in identifying and prioritizing needs, designing the research if it involves on-farm or chain investigations, observing and commenting on the research process, providing feedback on the outcomes, and helping design relevant solutions to farm or chain problems. The role of the researchers is to facilitate this process, conduct the research, and publish the results (Figure 3).

Conceptually, this is a multi-level process, with action research and action learning processes occurring at the farmer group level, chain level, and at the industry/political level. While much traditional research and development focuses on farmers, interventions are required along the chain as institutional buyers often lack understanding

of farmers' problems. With a whole chain focus, development workers can assist chain actors to work with farmers to address supply problems as they arise, rather than blame farmers when difficulties occur or agreements are not met.

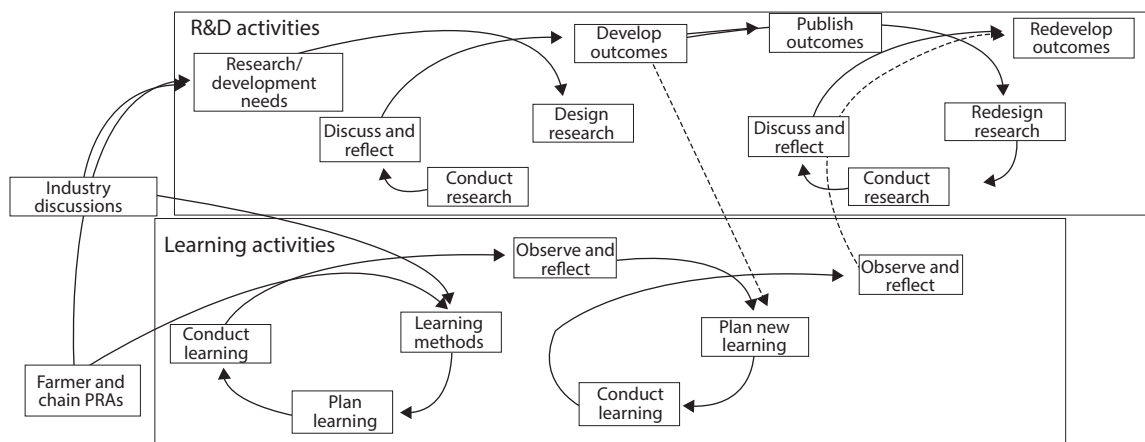
When using an agribusiness systems framework, farmer and chain level research and learning processes are obviously within the system, while industry and political level issues are mostly at the suprasystem level. As discussed earlier, many of the constraints to development exist beyond the farm and chain levels and require structural transformation involving holistic integrated approaches such as those implied by the AIS framework. Business, industry and financial regulations and policies, infrastructure, business development services, cooperative policies, and human capital development policies are among those issues that may need to be raised with the appropriate levels of government and business.

INTEGRATING R&D WITH EXTENSION

Another critical factor in agricultural development that is often overlooked or not properly integrated into the research and development processes is the extension function. Research is useless unless it:

- meets needs as perceived by farmers and their supply chain actors;

Figure 3: Participatory action learning/research process with farmers and industry



- provides practical solutions to those needs; and
- is integrated with the development and extension/rural advisory services.

To quote [Hildebrand \(1982, 111\)](#): “It makes no difference to a farmer how a third person views any specific technology. If he, himself, does not feel it to be appropriate, he is not going to be motivated to accept it.” The key problem arising from the implications of this observation is how to scale out from the project level to the general population of smallholder farmers. Developing strategies for scaling up and scaling out is a distinct topic that is beyond the scope of this paper; instead, it focuses on how the agribusiness framework and the research process discussed earlier link in and integrate with the extension functions in an AIS.

Five Key Extension Functions

There are many definitions and models of extension, but this paper makes use of the five models (or alternatively, functions, the term used henceforth in this paper) of extension outlined by [Coutts et al. \(2005, 21\)](#) and summarized in their capacity building ladder. The five functions are: (1) group facilitation and empowerment, (2) technology development, (3) information access, (4) programmed learning, and (5) mentoring and consulting. If private, NGO and government extension professionals are to have access to and promote practical solutions to meet the needs of smallholder farmers and their supply chain actors, then the R&D function has to incorporate a process that allows for effective participation of smallholder farmers and their supply chain actors. This is at the core of the model presented above, in which farmer groups and their partners (or in the example discussed, farmer marketing groups and their suppliers and customers) are facilitated and empowered by improving their social and human capital, but are also linked to an R&D process that develops relevant solutions to production, marketing, and enabling environment problems. Extension and rural advisory professionals (from government, NGO, and private sector) need to be

included in this process so that they will be able to scale out the relevant technologies.

Group facilitation and empowerment

[Coutts et al. \(2005\)](#) argue that the facilitation and empowerment function is about enhancing social and human capital. In the context of this paper, farmers, their communities, and their supply chain partners are encouraged to work together to improve the profitability and effectiveness of their chains, which in turn builds their levels of social capital, including bonding, bridging, and linking capital ([Heemskerk and Wennink 2004](#)). While marketing groups are the key focus of the agribusiness systems model, other groups have been effective in developing social capital.

The Landcare movements in Australia and the Philippines have developed bonding, bridging, and linking social capital that have subsequently been used to enhance outcomes from non-Landcare activities ([Murray-Prior 2014](#); [Gianatti and Carmody 2007](#); [Vock 2015](#)). Facilitation in this context involved participation by communities at the highest levels of Arnstein and Pretty’s typologies and is a core function for extension organizations. However, to be most effective, the culture of the extension organization must include a philosophy and practice that encourages true participation.

In Australia, former Landcare groups have become farmer productivity groups, as well as undertaking landcare functions, and developed partnerships with funding bodies, government departments, agribusiness companies and private consultants to undertake applied research, development and extension activities ([Gianatti and Carmody 2006](#)). In the Philippines, Landcare groups have become involved in cluster marketing and microfinance activities ([Murray-Prior et al. 2011](#)). More broadly, linking farmer groups to markets has empowered farmers and has been a driver of innovation and productivity improvements along smallholder supply chains ([CTA 2018](#); [World Bank 2007](#); [Shepherd 2007](#); [Bernard et al. 2010](#)). Group facilitation also provides opportunities for empowering women

to have a greater role in their families, in farming decisions, and in the supply chains (Viatte et al. 2009; World Bank, FAO, and IFAD 2009). Partnering and facilitating such groups where necessary have benefits for researchers and funding bodies as they incorporate farmer knowledge into their programs and are, therefore, in a better position to undertake relevant applied research, but also to undertake more relevant basic research to support applied and adaptive research.

Technology development

While the technology development function works best when development involves farmer groups and their supply chains, unlike the group facilitation function, the focus is on developing relevant “technologies, management practices or decision support systems which will then be available to the rest of industry” (Coutts et al. 2005, 19). Marketing clusters are ideally suited for technology development because they provide opportunities for transdisciplinary teams of farmers, value chain actors, NGOs, government, extension personnel, and researchers to address the highest priority constraints to improvements in the agribusiness system associated with the value chains. This is where the pluralistic, integrated action learning, and action research process undertaken using a dualistic agribusiness systems framework discussed earlier can be used.

The cluster marketing groups (or farmer productivity groups where cluster marketing is not relevant) are then embedded in the range of activities associated with the RD&E activities that will make them relevant to smallholder farmers and support the adoption of innovations. This strategy involves a paradigm shift so that rather than reductionist research strategies driving the change process, a whole-of-system approach to change is involved (Davis and Heemskerk 2012). It also involves considerations of changes in the policy and enabling environments (Roseboom 2012). The concept of farming systems research is enlarged to the agribusiness system and, consequently, “expands the specification of the problem and usually integrates technical innovation with institutional innovations in farmer organization and marketing

to ensure that results are used throughout the value chain” (Lynam 2012, 268). Such an approach also provides opportunities for enhanced public, private, and producer partnerships, which can have multiple development opportunities (CTA 2018).

However, many research projects are funded, developed, and managed by disciplinary researchers (Murray-Prior 2013) and, consequently, tend to follow a reductionist paradigm because that is the skill set of the managers. Many have good hard systems skills, but do not have a good understanding of soft systems, participatory, and facilitation processes or how to conduct transdisciplinary research. Some even perceive these paradigms as non-science. King (2011, 216) identified a need for collaboration facilitators in multidisciplinary or transdisciplinary projects who coordinate and mediate “responsibility across all contributing disciplines and practices within a project social network” to help overcome this problem. Consequently, project leaders of pluralistic, action learning, and action research projects should have a broad agribusiness systems perspective, the skills of a collaboration facilitator, and understanding of how to integrate extension into the R&D process.

Both Rasheed Sulaiman et al. (2010) and Klerkx et al. (2012) take this further by suggesting a role for innovation brokers or innovation intermediaries, who may not have a stake in the innovation process and therefore do not have preconceived views and approaches, to facilitate management of the innovation process. Klerkx et al. (2012, 53) define this role as “about performing several linkage building and facilitation activities in innovation systems, creating an enabling context for effective policy formulation and implementation, development and innovation.” They suggest this role may be undertaken by individuals or organizations.

While action researchers or extension professionals and organizations may be suited to this role, they often face perceptions that innovation brokering lacks scientific legitimacy or is not part of research and therefore should not be included in the research process (Klerkx et al. 2012). Often, funding and incentives are lacking and it is difficult to demonstrate the value

of innovation brokering. If the innovation broker takes too much credit, then they will generate animosity to them and their role, but if they are too subtle, their input won't be recognized. This is a classic problem implied in a quote attributed to Lao-tzu (6th century BC): "When the best leader's work is done the people say 'we did it ourselves!'" Nevertheless, collaboration facilitators and innovation brokers must have a greater role if the new AIS are to achieve their goals to assist with producing the food needed for the increasing world population.

Information Access

There are not enough resources for all farmers and chain actors to access learning opportunities and information through group activities under the group facilitation and technological development functions, nor are all people likely to want to be involved in such activities. Populations of smallholder farmers are large and farmer to rural advisor ratios are particularly high in developing countries, partly due to the small size of farms. Alternative information sources, including from cooperatives, contract farming companies, traders and retailers (CTA 2018; Da Silva and Rankin 2013; Da Silva and Shepherd 2013) are required to help fill this gap. Farmers will also require different types of information due to the nature of their farming and management system and their stage when adopting an innovation. Also, rural advisors need access to up-to-date information that is relevant to their clients (Murray-Prior 2013).

Provision of information is often taken for granted or has not been considered a particularly important method for facilitating change (Coutts et al. 2005). However, more recently, the advent of electronic communication technologies such as mobile phones, the internet, and pico projectors have created new opportunities to provide critical information to smallholder farmers and value chain actors. They also provide opportunities for the sharing and provision of information through the relationships between farmers, input suppliers, traders, contract farming companies, cooperatives, processors, market retailers, supermarkets and financial institutions.

FAO (2013b) for example, documents the use of information and communication technologies or ICT for providing information for three purposes: production systems management, market access services, and financial inclusion. These innovations now must be considered alongside more traditional sources of information. The range of media and formats available to provide access to information include field days, newsletters, radio programs, TV programs, newspaper and magazine articles, fact sheets, simple guides, physical and electronic decision aids, tweets, text messages, web and DVD videos, and multi-media messaging apps.

While there is considerable overlap in the type and form of information that can be made accessible through the various electronic and traditional media, extension communicators must have a clear idea of the purpose for using a particular media, and the type and format of information that they are best suited to providing. Some will be best suited to creating awareness and interest in an innovation, while others will be better for providing more detailed information. In general, they will be used as part of a suite of activities in an extension program that support and complement each other.

Information providers must be clear about identifying their target audience as, sometimes, the audience will not be the farmers (or end users) but may be intermediaries or next users such as field extension officers or input suppliers and other value chain actors. The information should also be relevant to the characteristics of the target audience, their needs, learning abilities, and access to the various media (Murray-Prior 2013). Behavioral economics can help provide insights into the design of information (and training) for supply chain actors, with Datta and Mullainathan (2014, 7) arguing "behavioral economics helps us understand why people behave and choose as they do." Mullainathan (2007) specifically discusses the implications of behavioral economics theories for the study of development issues, in particular for financial institutions, diffusion of innovations, poverty traps, social preferences, corruption, and the psychology of the poor.

This function should not be considered as separate from other extension functions and will be most relevant if it is based on the needs and solutions developed through the participatory processes of the group facilitation and technology development functions. An example of this is a participatory method for developing relevant technologies and linking them with a communication strategy developed and tested by [Van de Fliert et al. \(2010\)](#).

Programmed learning

Another function that can deliver specific knowledge and skills to individuals and groups is programmed learning, which consists of packaged information opportunities (field days, demonstrations, workshops, courses, seminars) that have specific learning objectives and a set curriculum. Normally, these activities arise from needs identified through the participatory functions or research and extension activities in other communities with related farming or agribusiness systems, where they may have been developed and tested to ensure relevance. A need may also arise for other reasons, such as disease outbreaks, or new government policies that have implications for management of farms, such as regulations, subsidies, and trade policies. Other organizations involved with the value chains (sometimes in partnership with government) such as contract farming businesses, cooperatives, farmer organizations, input supply companies, financial organizations, large consolidators, consulting companies and NGOs may also undertake programmed learning activities. Organic and Fair Trade organizations conduct information and training activities to meet the needs of their value chains ([Valkila 2009](#); [Becchetti, and Costantino 2008](#)).

While some regard programmed learning activities as a top-down process, this is not necessarily a weakness if they are based on extensive market research and pilot testing or are a response to industry or community demands ([Coutts et al. 2005](#)). In any case, the learning activities should be based on adult learning principles and be piloted through a continuous improvement process

(e.g., [Timms and Clark 2002](#)) and have sufficient flexibility to be adapted to meet the needs of different groups and communities ([Storer et al. 2011](#)). The content, delivery mechanisms, and trainers should be assessed throughout the program to maintain quality, while content and delivery may change with context (for example, locally relevant materials; case studies; timing; location of the sessions; and knowledge, cultural, and language skills of the presenters). Local farmers and chain actors can also be involved as presenters as this will increase the perceived and actual relevance of the program.

The programs can be presented to existing groups involved with the technology development or group facilitation functions, private sector groups, other existing groups, or ad hoc groups of participants. Sometimes, these ad hoc activities can improve social capital by linking participants to each other and to the networks associated with the presenters.

Mentoring and consulting

Traditional extension often involved working one-on-one with farmers, although government involvement in such activities has tended to decline in both developed and developing countries due to changes in economic philosophy and policy ([Rivera, Qamar, and Van Crowder 2001](#); [Marsh and Pannell 2001](#)). Provision of extension services has changed from the role of government to a pluralistic system involving NGOs, input companies, contract farming companies, private and company consultants, and farmer organizations. Technology development projects also often provide one-on-one extension to farmers, while government sometimes funds private sector consultants to provide this service to farmers, particularly for environmental programs. In developed countries, private consultants have taken over much of the individual consultant role, while in developing countries, farmers often obtain their information from their local agrovet or input store, who in turn obtain much of their information from chemical and seed companies such as East-West Seeds, Syngenta, and Monsanto.

Ideally, government technology development and related programs need to involve activities that ensure these next users of information are incorporated into their communication activities. Better still if some of them participate in the technology development activities and are used to extend this information to others.

MARKET-DRIVEN INTEGRATED RD&E: ADVANTAGES AND CHALLENGES

There are many advantages of participatory, market-driven, and integrated agricultural extension, development, and research aimed at smallholder chains, but the key advantage is that the focus is relevant to the key stakeholders—smallholder farmers and their chains, research and development professionals, extension professionals and development advocacy groups. The focus is relevant because it is based on the needs of the participants and develops and promotes innovations and solutions that are ready to be adopted by the relevant actors in the agribusiness system. It also is more likely to concentrate on the key constraints to improvements in the agribusiness system, as these have been identified by the processes involved.

The speed of adoption will be faster because the innovations and improvements are relevant and communication strategies for scaling out and up are developed and tested through the participatory processes. Also, an integrated action learning and action research process is ongoing and reflective and, therefore, encourages continuous improvement. In addition, all the relevant extension functions can be included in the planning of the programs.

A key issue for researchers is how to advance within their discipline, yet conduct research that is relevant to the end users of their findings. The process outlined in this paper allows them to work and publish within their disciplinary paradigm, yet provide useful results. It also enhances their systems understanding, which expands their appreciation of where their discipline is relevant to the system. For extension professionals in government, private, and NGO sectors, key issues are developing relevant technical capacity and lack

of recognition of their role. Those involved in the action learning and action research process can enhance their knowledge and skills, while their expertise has a better chance to be recognized when they facilitate the participatory processes. If those not directly involved are considered as part of the scaling out and up processes, the need for development of their capacities will be recognized and addressed.

However, a complicated process such as this involves challenges, including the time taken to organize the engagement activities, which is seen by some as a weakness of the process (Coutts et al. 2017; Botha et al. 2017). Additional problems include: lack of understanding of the process, the different mindsets and agendas that some people and groups bring to the project, threats to individual and group control over research and its funding, a lack of organizational support and funding for these approaches, and differing perceptions of ownership and urgency by stakeholders (Rijswijk et al. 2018; Coutts et al. 2017; Botha et al. 2017). Regardless, an effective AIS also requires a conducive enabling environment for the economy as a whole and the agribusiness sector in particular. Unless addressed, these challenges in the enabling environment could scuttle any efforts to improve smallholder farmers livelihoods, no matter how well intended.

CONCLUSIONS

The challenge of feeding the world population up to and beyond 2050 will largely depend on the ability of smallholder farmers and their supply chains in developing countries to increase their production, by substantially improving their efficiency and effectiveness. We must overcome many constraints if this development is to occur. This will require structural transformation and development of agricultural innovation systems that emphasize multidisciplinary and transdisciplinary RD&E, involve co-evolutionary processes, incorporate public-private partnerships, and are supported by greater investment and commitment to integrated RD&E for smallholder agribusiness systems.

There will be a range of approaches required to achieve this. This paper has outlined a framework that is suited at the program or project level of agribusiness development. It combines a dualistic agribusiness systems model, a pluralistic and participatory action research and action learning process, and a model for integrating research and development with five key extension functions. This will require changes in philosophy, practice, and commitment from the various players involved in developing the smallholder agribusiness sector: government, funders, RD&E organizations, and actors along the supply chains, particularly the institutional market organizations.

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