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Strengthening Partnership in Agricultural Research for Development in the Context of Globalization

KEYNOTE ADDRESS ON INTERNATIONAL COOPERATION ON COMMODITY CHAINS*

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INTERNATIONAL COOPERATION ON COMMODITY CHAINS[1]

Introduction

If we examine the facts of the last few decades, agricultural scientist should take justifiable pride in their role in helping to achieve what are truly remarkable ends. Over that time period, the world's agricultural systems have responded to the demands for food and fiber associated with:

- more than an 80% increase in population between 1966 and 1996 (World Bank),
- more than a 150 % increase in total GDP and more than a 40% increase in per capita income in that same time period (World Bank), and
- despite the increase in total population, an almost 15 % decline in the number of people malnourished between the early 1970's and the early 1990s (Bread for the World).

Attaining these achievements is due to many factors. One of those is the new knowledge created and delivered by the world's agricultural research institutions.

Despite these past successes, agricultural research systems need to be constantly striving to improve their performance and to expand their capability to serve mankind. The dynamic nature of agricultural systems means that new knowledge will be needed to just maintain our current productive capabilities. Population increases that seem predestined to occur over the next few decades demand that more food be consumed. Further, in many parts of the world, considerable portions of any increase in income that occurs will be devoted to consumption of the products of agriculture. These future developments likely mean that enhances in agricultural productivity must occur to maintain and enhance the well being of the world's peoples.

As agricultural researchers, we are very familiar with the notion that biologic systems are in a constant state of change. But we probably have spent much less attention on the notion that economic and social systems similarly experience continual flux. Indeed, change is the natural state of affairs in the more global, marketed oriented systems, which have grown in importance globally over the last 20 years (Schumpeter). These economic and social forces are critically important for agricultural researchers because the efficiency and effectiveness of our work will be greatly impacted by those changes. It is up to us to attempt to insure that the impact of our research is enhanced by these changes, rather than diminished.

In the remainder of this short paper, I will provide an economist's perspective of the strategic changes leading to fundamental redefinition of the food system. The next section of the paper will provide a conceptual framework through which changes in the agriculture and food system can be viewed. That framework is knowledge creation and its role as a driving force for change. With this framework, three alternative lens will be described which provide alternative views of what agriculture is and, therefore, the resulting role for agricultural research. The paper's final section will speculate as to implications and opportunities for agricultural researchers.

[1] Keynote address for the International Cooperation on Food Chains Sub plenary Session at the GRAF-2000 Conference, Dresden, Germany, May 21-23, 2000. Prepared by Steve Sonka who holds the Soybean Industry Chair in Agricultural Strategy, is Director of the National Soybean Research Lab, and is a Professor in the Department of Agricultural and Consumer Economics and in the Department of Business Administration at the University of Illinois at Urbana-Champaign

Nonaka and Takeuichi and the Knowledge Creation

Knowledge creation and knowledge management have become managerial buzzwords of the 1990s. Nonaka and Takeuichi (1995) provide a particularly useful evaluation of the process by which firms employ systems to generate decision relevant knowledge. Central to their analysis is the identification of two types of knowledge and the realization that the interaction of both types is critical to knowledge creation. Explicit knowledge refers to knowledge that is transmittable in formal, systematic language. Definitions, equations and theories in journal articles and textbooks are examples of explicit knowledge. Structured educational experiences typically emphasize the value of explicit knowledge.

Nonaka and Takeuichi (NT) make an important contribution by stressing the key role of tacit knowledge in the business processes. Tacit knowledge refers to the "mental models" that all decision makers possess of "how the world works". Tacit knowledge also can be thought of as know-how, experience and skill that we all use.

NT emphasize the interactive role of both explicit and tacit knowledge and stress that managers should define systems and processes to intensify the effectiveness of these interactions. When effective, such systems result in the knowledge spiral depicted in Figure 1. This figure stresses the interaction of explicit and tacit knowledge types. The upper left-hand quadrant, labeled observation, focuses on the decision maker's ability to recognize problems and opportunities, often from subtle, non-written cues. The experienced manager (whether a farmer or a food processing plant manager) who seemingly can sense that performance problems exist even when they are invisible to others exemplifies this tacit, observation phase. The documentation (upper right-hand) quadrant recognizes that tacit observation by itself often is insufficient. The process of making tacit knowledge explicit that occurs in the documentation phase is necessary for effective communication but this step also results in clarification of the situation. The lower right-hand quadrant, analysis, refers to the type of intensive study and investigation that we typically assign to analytical problem solving and research. The fourth section of Figure 1, labeled implementation, recognizes that there are tacit knowledge creation opportunities associated with the application of recommendations and technologies that result from formal analysis.

The circular set of arrows shown in Figure 1 illustrates the knowledge spiral concept advanced by NT. Their analysis emphasizes that effective knowledge creation (similar to Senge's (1991) organizational learning) is a continual process, incorporating both tacit and explicit knowledge. NT conduct their analysis in the context of the individual firm. However, this framework is relevant at the market and industry level as well. Indeed the knowledge spiral of Figure 1 appears, at least partially, to explain the historic effectiveness of the Land Grant university /U.S. Department of Agriculture research/extension system in U.S. agriculture. From a global perspective, the NT framework validates the long-held views of the superiority of farming systems research approaches in developing agricultures.

Three Views of Agriculture

Many of us have spent much of our productive careers conducting research to enhance agriculture. Very seldom, however, have we critically addressed the question of what constitutes the agricultural system in which our research is to be embedded. The following discussion will identify three prototypical perspectives of what constitutes agriculture. As prototypes, these perspectives are generalities and won't exactly fit all real-world circumstances. Hopefully, however, they will provide reference points for the discussion of the characteristics of the most desired agricultural research system.

The farmer as consumer

In subsistence agriculture, there is little argument as to the appropriate food system perspective. Because the farm family is the consumer, improvement of the farm family's well being is a research objective that can most readily be linked to the goals of agricultural research. Of course, well-being of humans is an imprecisely measured construct and the sociological impacts of change can be complex. However, from nutritional and economic perspectives, measurement of improved well-being is relatively straightforward. Agricultural research, which enhances the farm family's capability in these areas, can focus on enhancing the effectiveness of the family's productive assets devoted to agriculture.

Commodity channels

Increasingly, large segments of the world's population do not produce the food that they eat. Whether in developed or developing world, the share of a nation's economy devoted to agriculture is in decline. Conversely, the proportion of the world's people living in urban areas continues to increase. Therefore, if agriculture is really about providing food and fiber to people, our view of the agricultural system needs to change as well. In developed nations, commodity food systems have evolved to link agricultural products with their eventual consumers.

Systems analysis provides us a powerful tool to examine the dynamic characteristics of commodity agriculture. Figure 2 illustrates a very simple depiction of supply and demand interacting in a market. For example, let's assume the market is rice and that an increase in demand occurs for rice. The notion of the arrow with a + sign by it means that the increase in demand will lead to an increase in the market price for rice (everything else held constant). The = sign notes that there is a time delay between when the increase in demand occurs and the rise in price. Following along in Figure 1, the arrow (with a + sign) between price and supply indicates that the increase in price will lead to an increase in supply. Again a time delay between those events is indicated as it will take time both for producers to recognize that the higher price exists and then to respond through investments that lead to increased production.

Figure 3 embellishes the supply/demand perspective just shown to explicitly recognize that the market coordinates the actions of two sets of actors, labeled farmers and processors. (Of course, Figure 3 is a simple and general description. In reality, there may be several actors between the farm level and final consumers.) The message of Figure 3 is that coordination in this commodity world is achieved through actors observing and responding to two variables, price and supply.

Looking at the farmer "circle" first, farmers observe the price that exists and with that information form expectations as to whether investment should occur at levels, which will expand, contract, or maintain production levels. Those expectations, along with financial constraints and other factors not explicitly shown, result in actual investment in this season's crop. The actual investment (here defined broadly to include the time and energy of the producer as well as financial investments) and other factors such as weather result in the quantity of output produced. This quantity feeds into the market to determine total supply.

A similar process is depicted at the processor level. Here the supply of the agricultural product is a major factor affecting the processor's profit. Investment expectations are driven by profits and lead to investment of resources by the processor. (Again a number of other factors affect these decisions but they are not shown here for simplicity.) The output at the processor level is defined here in terms of specific attributes that consumers desire. This differs from output shown at the farm level, which is defined as quantity. Typically in the commodity channel it has been the responsibility of the processor to take farm output, measured relative to fairly coarse quality standards, and to convert that output to meet the more specific needs of consumers.

Agricultural systems are characterized by time lags and biologic uncertainty. Therefore the dynamic process shown in Figure 3 would not be expected to be in equilibrium, where the quantities supplied and demanded routinely meet expectations. Indeed Figure 4 illustrates the typical cyclical nature of supply in a commodity system. To link Figures 3 and 4, remember that when production levels are high, farmer profits are low encouraging reductions in production. Conversely when farm level production is low, processor profits are low that encourages the processor to set higher prices to encourage production. These forces tend to result in the cyclical pattern noted in Figure 4, however, fluctuations in weather and government policies often disguise these cycles.

Figure 5 expands the information flows of the commodity channel to illustrate (again very simply) the enhanced linkages that exist in food chains. Here two information flow arrows have been added (to the commodity setting of Figure 3). These represent information flows from the farm level to the processor and vice versa as to what actual investment levels are at the time those investments are made.

Prices and actual quantities produced still play an important role in food chains. But the information transmitted is enhanced in two aspects. One relates to timing of information availability. Time lags can be reduced if decision makers know. at the time of investment, what the investment amounts are. Further, uncertainties due to stochastic variability are reduced if the decision makers know both the investment levels and the actual quantities produced. Figure 6 illustrates the effect, in supply chain terms, of this additional information. The commodity channel cycle is shown exactly as it was in Figure 4. However, the added food chain cycle has fluctuations with reduced amplitude and the time to respond to a fluctuation is reduced. These advantages, although shown as relatively small changes in Figure 6, have profound economic implications. Further the findings of Figure 6 are very robust, having been documented in numerous case studies and in careful modeling investigations (Sonka, et. al.; Cloutier)

Another key feature of food chains is indicated in Figure 6. The output at the farm level now is defined as amount of specific attributes. This differs from the simple quantity output expectation of the commodity channel. Food chains typically operate through expanded quality expectations at the farm level. These farm level quality factors allow greater efficiency at the processor level or provide attributes that consumer segments desire. As information technologies and organizational structures evolve to make it less costly for information attributes to be captured, analyzed, and communicated, economic and market forces favor the development of food chains to exploit the benefits noted previously.

Research Implications

The preceding section outlined three typologies of agriculture. Which one of those we select as relevant shapes our perspective of the most appropriate agricultural research strategies. For subsistence and commodity channel settings, the focus of agricultural research appropriates centers on problems and opportunities almost exclusively at the agricultural production level. However, shifting to a food chain perspective requires the creation of new knowledge that has differing features. A few of those differing features are addressed in the following paragraphs:

Expanding the scope of inquiry

Our experience, based upon agriculture as subsistence farming or as a commodity channel, has taught us that that the appropriate boundary for agricultural research is the farm. Improving productivity at the farm level has been the appropriate test of the applicability of research findings. For agriculture comprised of food chains, a more comprehensive perspective is required. To be most useful to decision makers in food chains, including farmers, innovations will need to be evaluated across the following three dimensions:

- Agronomic and economic effects at the farm level,

- Effects upon the value earned downstream of the farm, including effects on final consumers, and
- Environmental and food safety effects.

To be most effective, innovations developed by agricultural researchers will need to be evaluated across all three of these dimensions whereas our focus in the past has tended to be primarily directed to agronomic impacts at the farm level.

Broadening the scientific enterprise

Application of the scientific method to agriculture has brought immense benefits to society. Because of the complex nature of biologic systems, the fundamental approach to inquiry has been to restrict the pursuit of new knowledge to investigations where the casual factors can be well controlled. This naturally implies that agricultural science occurs within the lab and at the level of experimental plots.

Operation of food chains often generates data and information that is explicitly captured. Therefore our definition of "good" science should expand to encompass analysis of results at the farm level as well as at the levels of the lab and the experimental plot. In terms of philosophy, of course, this observation is similar to that of the farming systems research approach. However, because technologies are making it increasingly possible to capture operational data, operation of effective food chains will rely upon generation and analysis of operational data. To accomplish this goal, expanded analytic capabilities will be needed.

Creation of food chains as a research activity

The questions of who creates and who operates food chains should be part of the agricultural research institutions agenda. Often we perceive that large food-oriented corporations are the only means by which the output of food chains can be effectively marketed. This need not be the case, however. In the United States, for example, a number of agricultural cooperatives have evolved as food chains, creating and using powerful brand names to respond to consumers. Westgren provides a very useful discussion of experiences in France where food chains have developed that are farmer led and controlled. Their effectiveness, however, is predicated upon the development and operation of systems that provide value to consumers. Knowledge of how to create such systems and the means to continually expand the understanding of consumer needs and desires is essential to food chains. Public sector research may be the only means by which producer groups can be involved in an entire food chain.

Agricultural research to serve multiple agricultures

Earlier three "views" of agriculture, subsistence farming, food commodity channel, and food chains, where discussed as typologies of agricultural systems. However, as is often the case, reality is not as simple as typologies and it is likely that two or all three of the settings depicted by those views will be in existence simultaneously. One of the challenges for public agricultural research institutions will be allocate their resources and energies across the needs of the differing agricultural systems. Effective cooperation with private sector research capabilities is one means by which the resources of public institutions can expand the impact of their work.

Summary Thoughts

Although agricultural researchers can take pride in their past accomplishments, the future challenge to effectively feed the world while minimizing the effect on natural resources is a daunting one. The development of food chains is a natural economic and market response to consumer needs on the one hand and innovations in information technology and organizational structure on the other. The food chain system requires the continual production and use of new knowledge to be most effective. It is critically important that the world's agricultural research institutions evolve and collaborate to best fulfill their missions in the context of food chains as a market institution.

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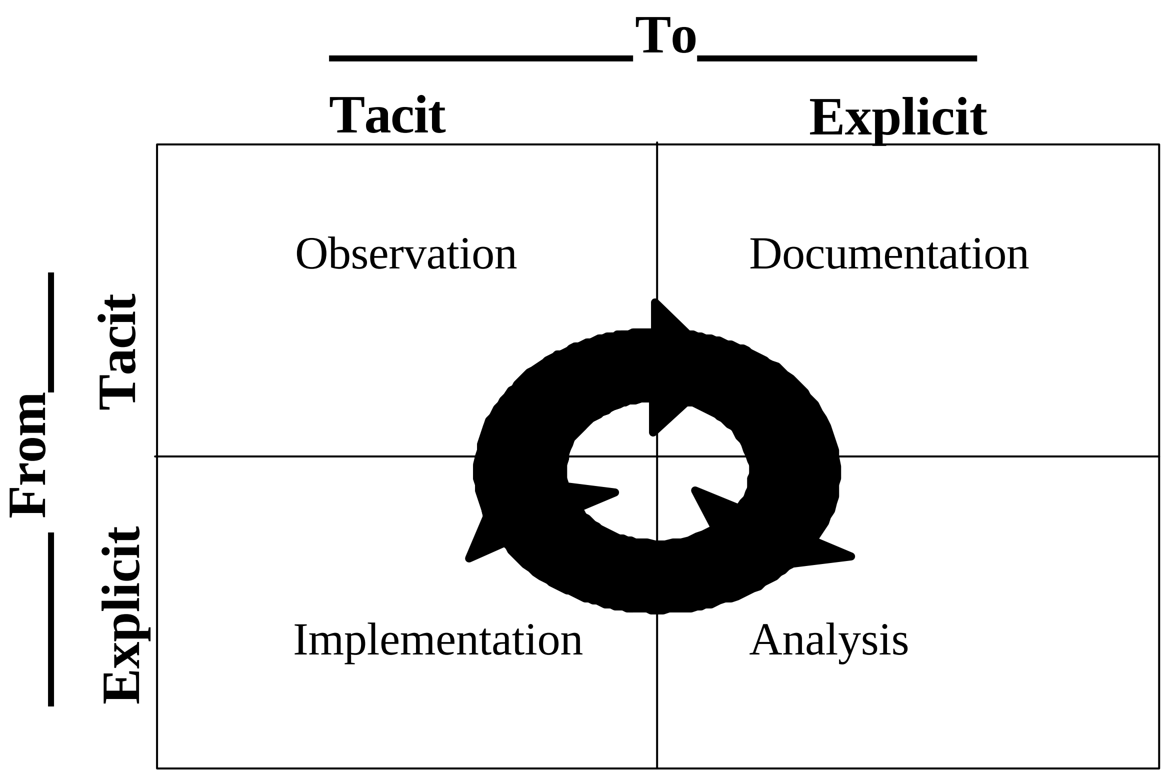
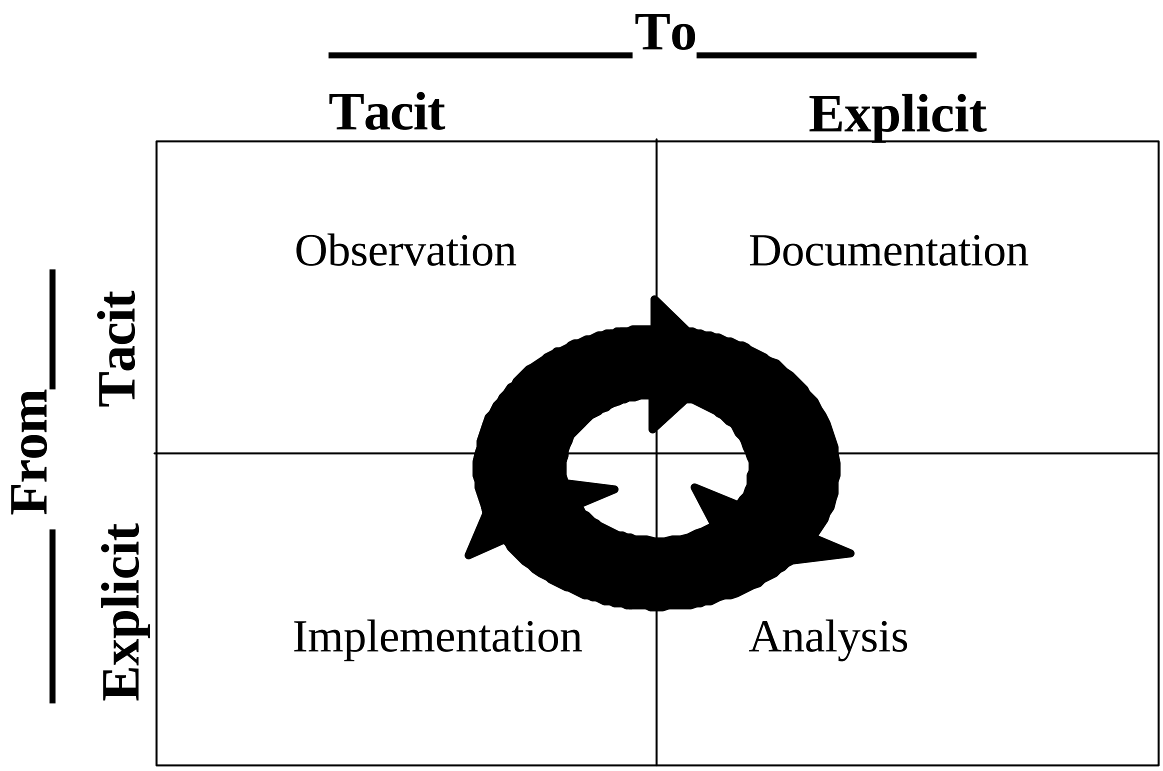


Figure 1. Knowledge conversion in a knowledge creating system (adapted from Nonaka and Takeuichi)



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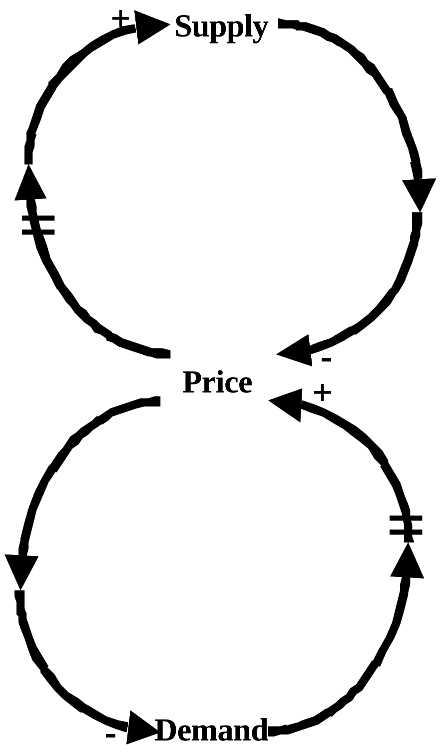

Figure 2: Commodity Market Dynamics

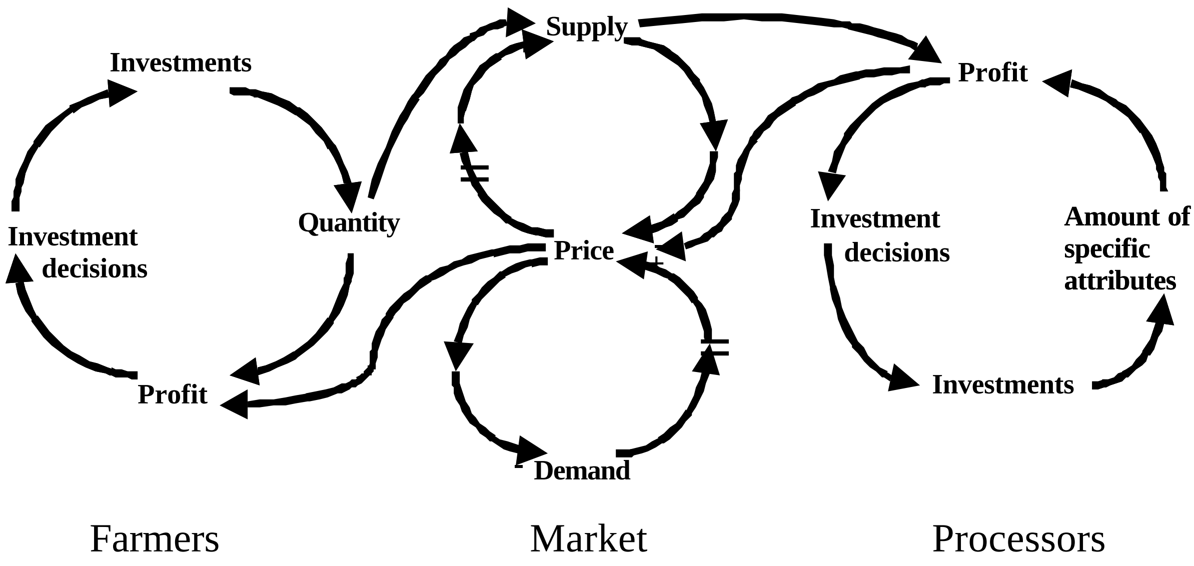

Figure 3: Dynamics of a Commodity Food System

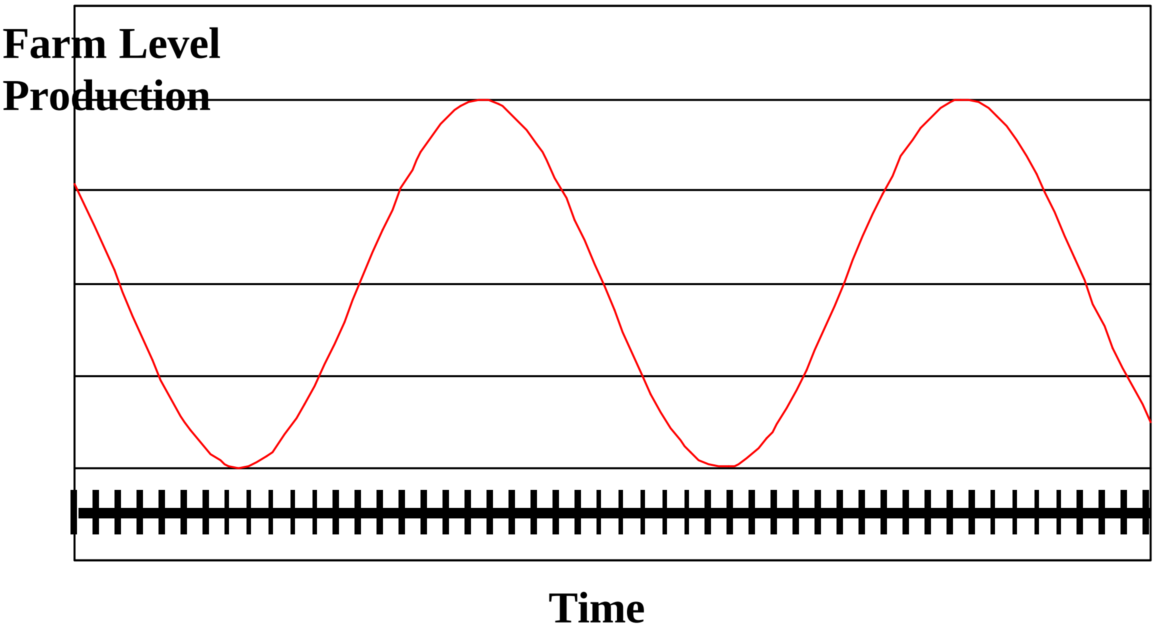

Figure 4: Classic Commodity Production Cycle

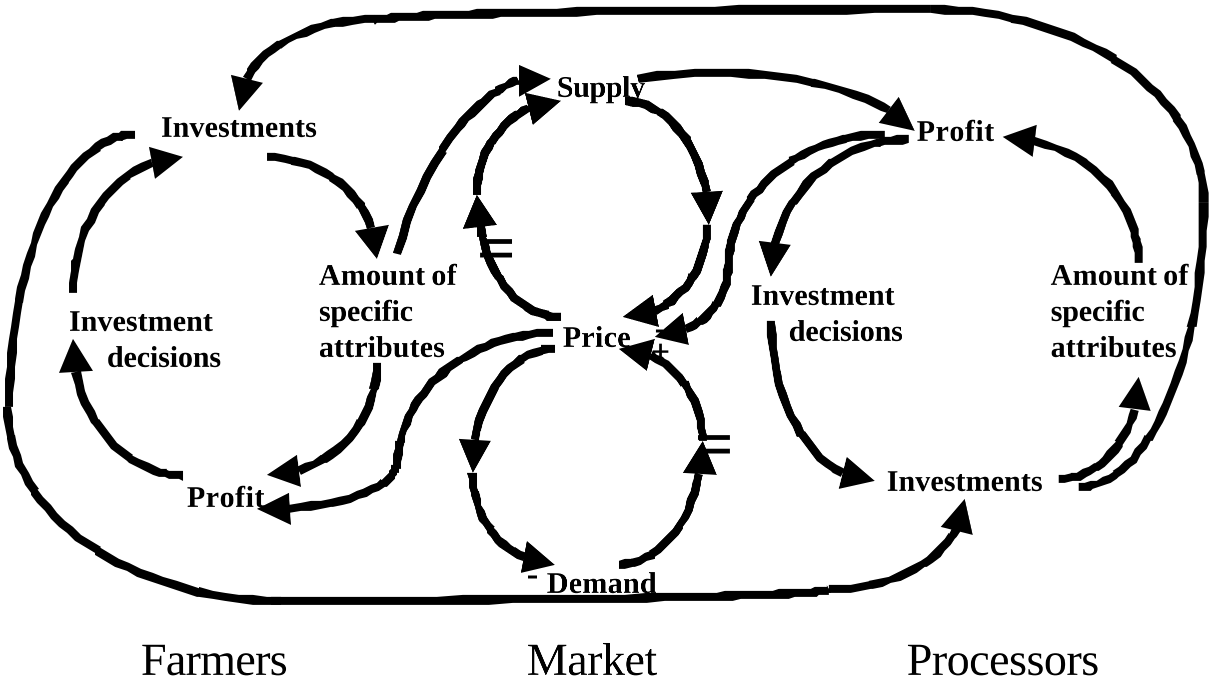

Figure 5: Dynamics of a Food Chain

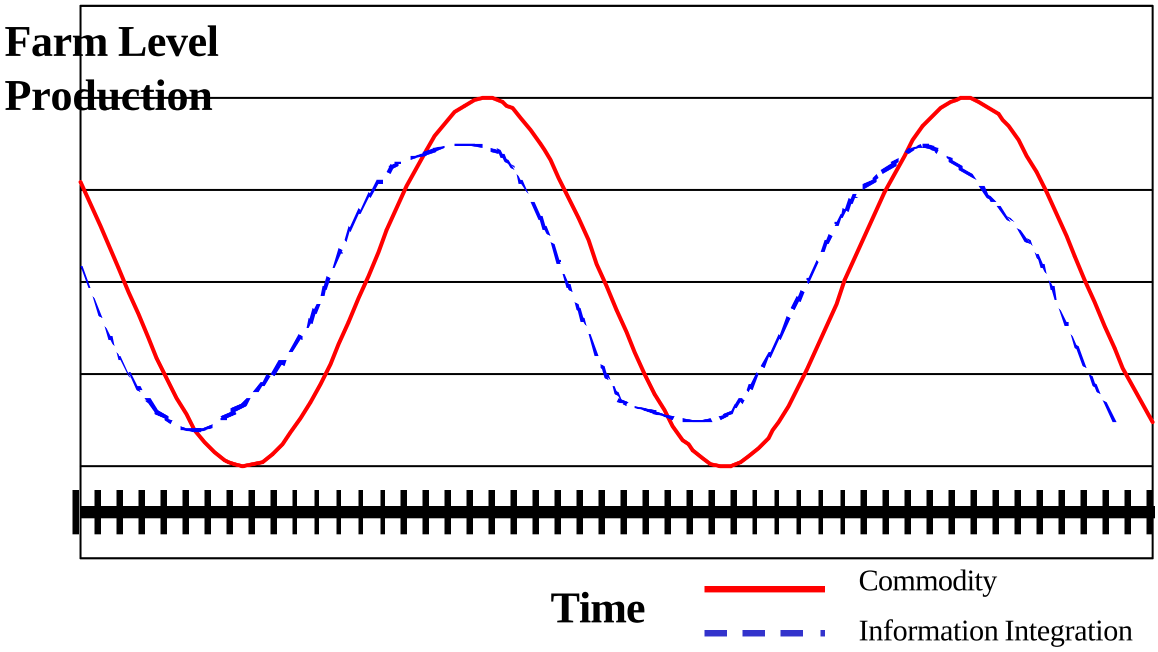

Figure 6: Information Integration versus Commodity Production Cycle