

Food Security and Innovations

Successes and Lessons Learned



Franz Heidhues / Andrea Fadani (Eds.)

International Symposium 1996



Eiselen-Foundation Ulm



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Welcome Address

Hermann Eiselen

It is my great pleasure and privilege to extend a warm welcome to you on behalf of the Eiselen-Foundation in Ulm.

This Symposium was initiated and is largely funded by this foundation. Since about 15 years it supports research projects and supplies scholar- and fellowships for graduate and post-graduate students of the Hohenheim University. This support is directed towards studies of different approaches to the problem of food security in countries suffering from deficits in food supply. By the way: Far from being immodest I would like to mention that so far my foundation is the only purely private attempt in this area in Germany to address the problem of hunger in the world. Unfortunately, this seems not yet to be an attractive field for private activities. I hope that this Symposium will help to convince others, that the private sector has an important role to play in supporting research and other efforts directed against hunger in the world.

Please allow me a few more personal remarks. Back in 1960, my father met Professor Joseph Knoll who at that time returned from Rome having served at the FAO as the head of the Plant Production Division and deputy Director General. Professor Knoll told us what was not widely known in Germany in those days when we were fully engaged in the reconstruction of our country after World War II. His message was: there is much hunger in the world and it will get worse unless we start doing something about it. So my father and I started our activities to fight hunger, the most inhuman of all situations people are confronted with, by sponsoring teaching and research against hunger at this University. Why do I mention this? Because my father who passed away in 1981 would be 100 in a few weeks. It was his and Professor Knoll's idea to intensify agricultural research for food security. Therefore I thought it appropriate to honour those two men by initiating such a scientific congress in order to review what we have learned so far and to stimulate further activities to reduce hunger in our world. Today - it seems to me - there is an abundance of ideas and research results but a lag in implementation. The more - unfortunately - the funds for international agricultural research are shrinking the more we should strive to improve the transfer and the extension of know how in order to effectively help the poor to a better life.

After having made you acquainted with my motives and some of the thoughts underlying my foundation, I want to cordially thank you for your active interest:

- the members of the program committee particularly the members from abroad who have made such a big effort to assist;
- the organizers and their support team who all did a marvelous job, especially Franz Heidhues and Andrea Fadani;
- the participants, among them there are the 63 speakers from 24 countries and more than 25 scientists who agreed to chair the working groups;
- and all those who have prepared posters.

Let me conclude with my best wishes and the hope for fruitful and inspiring discussions to accompany this congress so that all participants will experience it as a benefit and encouragement for their future engagement. May this symposium be a step forward towards freedom from hunger in the world.

Food Security and Innovations: An Introduction

Franz Heidhues

In today's world, food insecurity is widespread. More than 800 million people suffer under inadequate nutrition and 180 million children live on diets that are inadequate to develop their mental and physical potential. Also in the forthcoming decades food insecurity is likely to remain the most critical issue of the development agenda. The World Food Summit has agreed on the goal to cut the number of hungry people in half by the year 2015, a goal that has been criticized as too modest. Nevertheless, with population growth in much of the developing world continuing at high rates and with increasing scarcity of land, water and other natural resources, achieving the World Food Summit's goal of halving hunger within the next two decades poses an enormous challenge.

Perspectives and Challenges

Numerous factors determine whether the challenge will be met: a proper institutional framework, conducive policy environment, human, physical and social capital formation and infrastructure development are generally recognized as important elements. The component that has been most vital in securing adequate food in the industrialization process of today's developed world has been generating and applying knowledge in food production, processing and marketing and creating the institutional and policy framework that supports acceptance of those innovations.

Similarly, in meeting the future food security challenge innovations in agriculture will play the most vital role.

During the last four decades governments, international organizations and private sponsors have spent substantial amounts of funds on developing and introducing agricultural innovations. Important productivity increases, such as the green revolution technologies, were the result. However, successes were uneven and in some regions, among them large parts of sub-Saharan Africa, the innovation process did not produce the expected results. Often it failed entirely. Also the benefits of innovations were shared unevenly.

Recognizing that eliminating hunger will only be possible if innovation driven productivity increases will provide the needed growth in food production and that the innovation process raises extremely complex issues, the sponsors and organizers decided to devote this symposium to the issue of food security and

innovations and the complex interlinkages between them. The intention of the symposium was to bring together the wide-ranging experiences of different disciplines with innovation processes, to share cases of success and failure, to highlight communalities and differences and, thus, to advance our understanding of the innovation process and to identify knowledge gaps that need further research. This volume includes those papers discussed at the symposium that made a particular contribution to this objective. In this way, the editors hope to contribute to the formulation of more effective food security and innovation support policies.

The papers of **Part I** are addressing the perspectives of the world food situation and the role that innovations play in ensuring food security. Are we certain that the resources of our planet will be sufficient to guarantee food security of the expected world population of ten billion or more in the next century? Will we be able to leave to our children the resources needed to achieve this, and will we be able to develop the political, economic and ethical models ensuring a fair sharing of those resources? Dresrüsse highlights the enormous challenges that these issues pose and provides a vision for a strategy of participatory development co-operation very much needed if we are to succeed in tackling these tasks.

Globalization and liberalization of markets are mobilizing a tremendous development potential, particularly in Asia and Latin America. However, Africa is largely left behind. What has liberalization done to poor countries' terms of trade, their food security and what has been its impact on food prices and food aid availability? What needs to be done to reintegrate Africa into the mainstream of development and which role have agricultural research and innovations to play in this process? These are questions that Sir Hans Singer addresses in his global view on food security. He also sounds a warning to all those who criticize food aid. He envisions that the world will need more rather than less of it.

Understanding the innovation process and formulating a co-ordinated and synergies' maximizing innovation policy is not possible without a theory-based conceptual framework. Walter in his contribution „Foundations of Innovations“ builds a theoretical frame on the basis of Schumpeter's innovator-imitator model. Integrating the subsequent contributions of economic as well as other disciplines, such as history, sociology, anthropology and political sciences, he shows the full complexity of the innovation process with its numerous feed back loops and linkages. The answers to key questions of the innovation process, what drives the innovation process, what makes individuals or enterprises to be innovators, why are some more innovative than others, why do some innovators find imitators and others don't, and what is the significance of the institutional and policy framework, are complex. The profit motive in a competitive environment that

economists see as the key driving force of technical progress may go a long way in explaining the start of the process. But what keeps the process going? The evolutionary approach to economics, drawing parallels to the biological evolution theory and the theory of organization provide interesting insights. Walter sees the innovation process as an interacting process between the techno-economic and the socio-institutional systems where historical, political, social, institutional and environmental factors play a frame setting role. In this framework the innovation process is time and location dependent and, thus, remains itself a research issue, a point that von Braun strongly emphasizes in his „Conclusions for Policy and Research“. Moreover, as he points out, not only can food security policy reap benefits from a better understanding of the sources and driving forces of innovation, but equally from clearer insights into the food security - innovation interface. A host of questions and ideas have been raised in various contributions to this symposium. They need to be translated into comprehensive research agenda.

Although growth in agricultural and food production can be achieved through a variety of complementary and co-ordinated actions, the rapid transfer of technology is an important ingredient to this process. The importance of technical change in developing countries' agriculture has increased because of increased costs as a result of currency devaluation, reductions in subsidies for fertilizers, water, electricity, credit, and government price support programs. Lele examines the process of technology generation and transfer along with the strength and limitations of the current models of transfer.

She discusses several reasons why research should be considered an international public good and, thus, is justified to receive public funding. An efficient system of networking is needed to increase the benefits from research carried out at various levels by the international and national research systems. Human as well as biological and physical factors explain the vast differences in the speed of technology generation and adoption among countries. She argues that efforts must be made to increase investment in research and in the development of technology. Different forms of collaboration and farmers' participation are needed.

Generation of Innovations

The papers in **Part II** deal predominantly with the generation of innovations. A number of papers demonstrate how closely linked and interwoven in practice the generation and adoption part of the innovation process are. The role of public policies and support for agricultural and food research, commodity, filière or farming system approaches for research priority setting and strategy formulation (Bosc and Freud), the use of local ecological and technical knowledge, creativity

and group learning dynamics (Gupta et al.) and natural resource and environmental constraints as a source for research themes (Mohr) are addressed in Chapter 2.1. The rest of Part II presents a host of examples and case studies of innovation generation in plant and animal production (Chapter 2.2) and economics (Chapter 2.3). Natural resource, environmental, economic and institutional constraints often appear as prime movers of innovation generation, interacting with new technological possibilities, such as biotechnologies, and innovative forms of research co-operation.

Innovations in Plant and Animal Production

Several papers were presented in the symposium concerning the generation of innovations in plant and animal production. Kroschel et al. examine how control methods of the pernicious weed *striga*, one of the most harmful constraints to increased food production in Africa, can be made more effective. African farmers so far have little benefited from decades of research carried out to develop *striga* control methods. Have research and extension adequately considered local knowledge and indigenous farming practices? Has the approach in controlling *striga* been sufficiently system-oriented to take into account national and regional interdependencies? These are questions that this paper highlights.

Biotechnology has become an integral part of modern plant breeding, and different methods have been used to accelerate breeding programs. Which methods are applicable under developing countries' circumstances? Weber's paper presents different biotechnological methods and discusses how they can usefully be applied in banana, potato and cassava breeding. It is noteworthy that the transfer of biotechnological innovations does not necessarily require major investments in basic research and that small farmers can implement the technologies at low cost. Other examples are the introduction of stem borer resistance into the germ plasm of an indica rice breeding line by the transformation of indica rice breeding line IR58 with a synthetic version of a truncated *CryIA(b)* gene from *Bacillus thuringiensis* and the improvement of Guinea pig breeding and husbandry (Zárate and Horst).

Integrating aquaculture and agriculture in small farm production has a long tradition in Asia. Based on empirical data Gupta et al. show that the integration of rice and fish farming can increase rice yields at low cost and risk and provide multiple benefits. An important ingredient of such a system is integrated pest management that also leads to less weed infestation.

Economics and Innovation

A precondition of broad acceptance is the innovations' profitability. A wide variety of papers discuss this topic, among them Kunze et al.'s paper analyzing

the profitability of soil conservation measures in West Africa, home processing technology for soybean production in Zimbabwe (Mudimu), Gauchan's examination of fruit tree integration into the existing production system and Drescher's analysis of home gardening as an important component of the family food production system. Home gardening can be a potential and important contributor towards rural and urban household food security. Its significant contribution to the overall food supply is often overlooked and it certainly deserves more attention in agricultural research and extension.

The comparative advantage of home gardening is examined by Marsh. Two case studies, one from Bangladesh and the other from Central America, analyze under which conditions home gardening is a viable way to improve food security and what useful role community based organizations can play in introducing and diversifying home gardening.

Farm mechanization is a very controversial issue in developing countries in general and in Africa in particular. Animal traction has been one of the most important steps in the technological change and in the intensification of agriculture in many countries. On the basis of farm/household data from Benin Brüntrup investigates why the adoption of animal traction in Africa has been found to be so low and what measures can help its wider application.

Policy and Institutional Framework

Institutions and policies play a key role in the innovation process. This is generally recognized. What is less widely accepted is the fact that institutions and the policy framework are important research areas themselves.

Agricultural research is the basis of the innovation process and its contribution to food security. How to define research priorities, how to design funding mechanisms that ensure agricultural research is responding to farmers' needs and what should be the respective roles of the public and private sector in this process, these questions are discussed by Lichtblau and Chataigner (Part III, Chapter 3.1). Imagination and willingness to experiment may open up whole new avenues for research funding. Extremely interesting aspects are brought forward in research work looking at specific policy areas, such as Hitzel's and Mbabu's work on Kenya's dairy development policies, and Virchow's analysis of the resource allocation process for promoting sustainable land use systems. As Virchow points out, without poverty reduction and improved food security, sustainable land use and natural resource protection are difficult to implement. Reardon and his colleagues analyze agricultural development paths searching for the best option to meet the dual need of agricultural productivity increase and environmental sustainability. Do we have to rethink fertilizer subsidies for soil

fertility and soil conservation investments? The issue is the proper role of public policy, particularly in support of investments in natural resource conservation.

Institutional innovations can have a variety of origins. Schrieder discusses innovative approaches to rural financial market development that originate in informal financial sector activities and are adopted in formal sector institutions. She analyses how financial organizations of the formal sector adapt, adopt and spread innovative practices of the informal sector, broaden access of poverty groups to financial services and thus contribute to better food security. Is lending to the rural poor increasing lending risk and the default rate? In their research Sharma and Zeller address the question what institutional structures need to be put in place so that there is no conflict between prudent financial management and lending to the poor. Addressing the financial needs of the clients and building long-term, from the clients' point of view worthwhile associations seem to be key factors.

Also von Oppen and his colleagues find an increasing need of public sector support for rural infrastructure. They show substantial efficiency and equity effects of improved market access.

Policy and institutional innovations raise issues not only at the macro and sector level. Of particular interest is their impact at the farm household level where such innovations directly influence household behaviour. Hengsdijk and his colleagues discuss a farm household modeling approach that allows analyzing the impact of innovations on household income, land use and the natural resource base. Similarly, Beerlandt, Tollens and Dercon analyze a methodology to identify the food insecure and the root causes of food insecurity at the household and local level. Too often, food security programs are planned and carried out on the basis of inadequate knowledge about where and who the food insecure are. Interventions then fail to reach the target groups and miss to address the root causes of food insecurity. A different methodological approach that is trying to encompass the complexity of the food security issue is presented by von Bach and Nuppenau in their paper on analyzing linkages between policies, socio-economic conditions and food security. Their latent variable model combines food security and health indicators with farm performance coefficients and variables describing general socio-economic conditions.

Diffusion and Adoption of Innovations

Part IV is devoted to the diffusion/adoption phase of the innovation process. Issues of a general nature, including innovations aimed at improving structure, organization, international cooperation and impact assessment of international agricultural research (Bonte-Friedheim and Ashri) as well as networking (Ausher) and farmers' participation in agricultural extension (Huddleston) are raised.

Ausher analyses the major problems in extension systems including management and professional issues. He calls for the establishment of an international *clearing house* to collect successful and unsuccessful case studies, performance data and experiences in order to improve methodologies for agricultural extension. The *clearing house* can provide extension workers all over the world with well-defined tools and methodologies and promote professionalism among them.

NGO and local institution involvement in setting priorities in research and extension (Fernandez and Beier/Boettcher) as well as a summary evaluation of the World Bank's experience with agricultural extension (Purcell) are discussed in various papers of Chapter 4.1. This assessment of the Training and Visit (T&V) system advocated by the World Bank indicates that there is no one single methodology with sufficient superior characteristics to warrant its universal use. The paper recommends that country-specific strategies and programs be developed relevant to the circumstances existing in each country. Local participation and the use of local resources in linking relief with development is being examined by Ashri and Boettcher. Programmes are found to be successful if they rely predominantly on local resources in which the local people are active participants. Good results can be achieved by combining local self-help with food for work programs of international donors and NGOs.

Specific Diffusion/Adoption Processes

Of the numerous case studies, including those presented in the poster session, Chapter 4.2 presents a cross section selection that tries to reflect the richness of experiences with specific diffusion/adoption processes discussed at the symposium. Diffusion/adoption studies in developing countries show that innovations, often developed on station, have rarely been adopted by the beneficiaries. Some studies argue that the lack of success in innovation adoption lies primarily in farmers' unawareness, while others attribute it to the inadequacy and inefficiency of the extension service. Only in rare cases is the knowledge generation process held responsible. Some of the most important papers presented along this line of argument include the following:

Lamers and Feil examine farmers' knowledge, extension capabilities as well as researchers' concept about technology. Farmers are often found to be aware of key problems they face as a result of experience, knowledge and tradition. Also resources, the environment, technology level and political, economic and market conditions may be favourable. Why then are agricultural extension services so often unable to fulfill, their assignment? Is it a lack of appropriate concepts, qualified staff or funding or have the economic and social implications of potential techniques and innovations not been adequately considered? The

authors argue that farmers need clear and convincing reasons why and how new technologies will benefit them.

Proper adaptation to local socio-economic conditions (Kwon et al.), a co-operation between the private sector and government extension organizations (Smitabhindu et al.) and involvement of clients in a participatory approach requiring a change in the roles of agricultural extension workers from being teachers to facilitators (Admassie and Hagmann et al.) are issues discussed in these papers. The efficiency of an extension system can be greatly improved through dialogue with farmers, farmers' experimentation and the strengthening of the self-organizational capacities of rural communities. How to institutionalize participatory approaches into often hierarchically structured organizations is a highly complex issue. To be successful, major changes in planning, implementation, monitoring and evaluation procedures are required. Moreover, the policy environment (Zeller, Adugna et al.) and farmers' attitude towards risk (Hedden-Dunkhorst) play an important role.

In issuing this proceedings volume the editors intend to share widely the successful experiences and the lessons learned in the endeavour to promote food security through innovations. We hope that this volume will contribute to stimulating further discussion, encouraging innovative thinking, initiating new research and formulating and implementing better policies and programs.