Raising Hope and Nurturing Options for Agricultural Development:

Essays in Honor of **Cynthia Bantilan**

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Raising Hope and Nurturing Options for Agricultural Development:

Essays in Honor of Cynthia Bantilan

Friends, Admirers n Students (FANS)

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ICRISAT
Science with a human face

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She Walks In **CONFIDENCE**

SHE WALKS IN CONFIDENCE, in cadence
slow and measured strides,

Commanding is her presence, a demeanour
she carries with grace and pride;

Her countenance is steady, and reassuring are
her eyes,

With authority she plainly speaks, in words
that are concise.

Decision-maker and a woman too, she is as
prudent as she is wise;

Quick to spot a talent—she cultivates, she
nurtures, and she gives advice;

To details she attends as only a woman can, a
gaping gender gap,

The world would be the wiser, if institutions
would amply tap.

Deliberate are her decisions, methodical,
unhurried even under stress;

She weighs the consequences, as principles she
treasures guide her quest;

Once past the point of confidence, she decides
and moves,

As effectively and efficiently as she has consistently proved.

In mellifluous voice, she speaks in earnest in presentations she makes,

Compelling, convincing, and illuminating to hear, the audience she captivates;

Her ability to communicate is extraordinary, a feather in her cap,

From data entry operators, to Members of Management at the top.

A number of her presentations she delivered more than once;
If you happened to be present in her repeat performance,
You would be amazed to find that it was not at all a bore,
Instead, like a melody heard, the same you want to hear still more.
Early on, she used fuzzy set theory in measuring poverty,
In consultation work with Prof Dagum at NEDA, a government agency;
She worked on wealth uncertainty in a life cycle model;
She analysed Philippine rainfall data using Markov-chain exponential.
Her heart is big to make a dent on lifting up the poor,
"Development pathways" and impact are her work's core;
To towns and villages, she goes and lives and eats with folks,
To see the poverty dynamics with which the poor are yoked.
Co-bread winner and mother, her three sons and husband she holds dear,
In thought and in her actions, their well-being is her only care;
She takes great pains to give her children an edge in life,
Their response to her love and care, makes her a fulfilled mother and wife.
Soft-spoken yet mistake not, she has a spine of steel;
Un-deterred, un-perturbed, calm and resolved she deals;
Incisive in resolving and decisive in her actions, is she,
No doubts nor regrets but forward looking to her mind is key.
When things go wrong, the buck stops at her desk,
She works a resolution, the problem she deftly puts to rest;
To the summit, she shows the way, in words and deeds,
The staff she does not manage—she L E A D S.

– Feliciano T Bantilan

A Biographical Sketch

Born first in a family of six siblings,
She naturally led in the business of living;
On her shoulders responsibility was laid,
She set the example in words and in deeds.

A civil engineer was her late father;
Her surviving mother is a retired teacher;
Each of the two was a solid educator,
But her father was her special mentor.

In their house, in Quezon City, he would sit her on his lap,
Waking her number sense, he taught her elementary math;
Her imagination to stir, her creativity to hone,
Grapes he'd produce, he claimed came from the moon.

Sharpened greatly were her math skills,
As father and daughter went over exercise drills;
She would easily win her class' top honours,
From a combination of nature and nurture.

An extracurricular activity was playing the guitar;
An orchestra member, she was, of University Centro Escolar;
She and others played once in a music extravaganza,
In the Philippine Philharmonic Orchestra, in Manila.

To do undergraduate studies, she went to Diliman, UP[1];
Pursued a bachelor in Statistics, and earned her degree;
With a Cum Laude, she applied and was accepted by IRRI[2],
But she opted, instead, for a teaching post at UPLB[3].

There she met her husband-to-be;
Who taught philosophy there previously;
When she came in, he was then teaching Physics;
She was teaching both mathematics and statistics.

Each was ambitious and big dreams each was after,
At Diliman UP, he was finishing his degree in a Physics Master;
At UPLB, she was finishing her Master's degree in Statistics;
With a minor, taught by Prof Evenson of Yale, in Economics.

ADC[4] of the Rockefeller Foundation, opened scholarships,
For degrees pursued in Agricultural Universities in the US;
A slot she got for a PhD in Economics and Statistics,
In North Carolina State University, she pursued her PhD studies.

At the same time, her husband-to-be obtained a fellowship,
From the Philippine Government for a PhD in the US;
All parties involved were unanimous—before they leave,
They must be wed and take the vow in marriage.

Off to the US they went, filled with hopes and spirit of can do,
She landed in Raleigh, North Carolina; he in Chicago;
After a while, their telephone bills were going ever higher,
A solution had to be found for the newly wed to be together.

Either she transferred to the University of Chicago where he was;
Or he transferred to a university in North Carolina, where she was;
Her scholarship was not flexible; but his—it was left to him to decide,
So, to Duke University, he finally transferred to be at her side.

In 1984, she obtained her PhD in Economics and Statistics;
She came back to UPLB, an Assistant Professor of Economics;
She had the knack of delivering lectures—stimulating and clear;
Award in the Social Sciences she won for being the Best Teacher.

In 1991, UPLB honoured her the Best Researcher in Economics;
For poverty and income distribution modelling and econometrics;
And work she did in a multi-country project funded by ACIAR[5]:
Research Priority Setting in Asian Agriculture.

She was a consultant to the Poverty Group at NEDA[6];
NEDA was then adopting the Model of Prof Dagum from University of Siena;
Then, Jim Ryan of ACIAR contacted her for a project to assess impacts;
This led, in 1991, to a Ryan offer to be leader of impact studies at ICRISAT.

The offer she accepted and started office in August 1992;
She daily commuted to ICRISAT campus in Patancheru;
Solidly she built the group—REIA[7]—to quantify ICRISAT's impacts;
To Research Priority Setting, REIA's assessments gave feedback.

Mainstreaming impact assessment in research mind set,
Was a challenge; in the end success her group did get;
Her stature grew, as well as her leadership responsibility,
She was made Program Director, in 2000, based in Zimbabwe.

In 2002, she came back to main Headquarters, still Program Director;
In the new reality, growing is the proportion of funds from private donors;

The last decade saw, in number of projects and of staff, a big expansion;
A large part of bill for VLS, TL II and HOPE is from Bill-Melinda Gates Foundation.

Year 2013 is special; she and her husband are proud of the three;
The eldest from Princeton U, in physics theory will get a PhD degree;
The second from CUNY, a Master's in Bio-Statistics and Epidemiology;
Third is pursuing an MS in Social Medical Sciences in Columbia University.

Her professional life she has spent in understanding the poor;
Delineation of pathways to rise from poverty is her work's core;
The team she has gathered has equally the same motivation;
It is expanding poverty understanding and its policy implications.

– Feliciano T Bantilan

1 University of the Philippines
2 International Rice Research Institute
3 University of the Philippines at Los Banos
4 Agricultural Development Council
5 Australian Centre for International Agricultural Research
6 National Economic Development Authority
7 Research Evaluation and Impact Assessment

Foreword

What is the appropriate goal of economic and social policy? Where people are starving, economic growth is universally viewed as the key objective. Food comes first and philosophising second. As economies get richer, however, they can afford to question the need for further riches. Greater wealth does not seem to buy extra happiness.

Everybody close to Dr. Cynthia Bantilan, however, knows that nothing can make her happier than creating options for agricultural development and raising the hopes of millions of farmers. Throughout her life, she has been tirelessly working for agricultural development in Asia and sub-Saharan Africa in various capacities, mostly documenting and studying the voices of the poor so that appropriate economic and social policies could be established to make the poor co-authors and not just bystanding beneficiaries of the development process. On the occasion of her 60th birthday, I am pleased to see that her *Friends, Admirers n Students (FANS)* have written a volume of essays on agricultural development as a fitting gift – to remind her of her wealth of friends, the reason for her being, the impact of her life's work, or simply to gift her with an extra iota of happiness.

As a colleague, I am delighted to write the Foreword for this volume of *Essays in Honor of Cynthia Bantilan* which will be published as an open access e-book.

Agricultural development planning requires an in-depth understanding about future scenarios and challenges which can be addressed in meaningful ways through allocation of resources, development of strategies and plans, and identifying priorities for agricultural research and technology generation. Knowledge about the technology needs of farmers and their technology adoption pathways helps scientists develop improved cultivars and resource management technologies suitable to farmers' needs. Feedback to policy makers and researchers about impacts of agricultural technologies on farmers and consumers are essential for promoting agricultural development as well as securing continuous financial support from development investors. Agricultural development also requires capacity building and nurturing brilliant young minds to work for agricultural research and development. Cynthia, throughout her life has worked on all these aspects and generated enormous wealth of knowledge and inspired many scholars. She has a good grasp on the future of dryland agriculture, and has been articulating emerging challenges and farmers'

needs for a long time. Her insights and recommendations for public investment, research priority setting, resource allocation and impact assessment particularly in dryland agriculture have been valuable to all concerned.

One of the Jewels of ICRISAT is our Village Level Studies (VLS). The first generation VLS were conducted from 1975 to 1984 and in 1989. Village level studies were revived at ICRISAT in 2001 under the leadership of Cynthia Bantilan. The revitalized 'Village Dynamics Studies in South Asia (VDSA)' have been providing quantitative and grassroots level insights and evidence on long-term poverty dynamics and determinants since 2009. Insights developed through these studies provide a wealth of information for policy makers and international development funding institutions to determine where to invest their resources and how. VDSA have increased the availability of reliable data to scientists, policy makers and donors, actually giving a voice to the poor and forgotten. These studies remind us again and again that the soul of agriculture remains in the villages.

At ICRISAT, we generate scientific and technological innovations to reduce vulnerability to drought and climate change while increasing crop diversity and value. We increase agricultural productivity to help end hunger and food insecurity. We create options and put forward insights to harness development pathways for inclusive prosperity; raise and secure productivity for health, income and sustainability. We work for development outcomes such as food sufficiency, intensification, diversification, resilience, health and nutrition, and women empowerment. We provide open access to the knowledge created by ICRISAT and partners. Open scholarship benefits the whole world's science, enabling the free flow of research information between north and south, east and west, helping research to progress much more effectively.

This e-book entitled *Raising Hope and Nurturing Options for Agricultural Development: Essays in Honor of Cynthia Bantilan* covers a wide range of issues. These include the future of rainfed agriculture, research priority setting, impact assessment, the chickpea revolution, biofuels, management of natural resources, agricultural diversification, gender equity, role of social networks for technology adoption, facing the challenges (risks and uncertainties) and tapping the opportunities presented by, say, FDI in retail marketing and regional cooperation for agricultural development. Open access e-books promote knowledge without boundaries. Thus, the book will promote our shared vision of a prosperous, food-secure and resilient dryland tropics and open access to knowledge for all.

I do hope that readers will enjoy the essays written by eminent and young scholars. Policy makers will benefit from insights and suggestions for policy formulation, development of projects and promoting regional cooperation for agricultural development. Agricultural scientists will find valuable information for development of technologies to cater to the needs of dryland farmers.

William D Dar
Director General
ICRISAT

Future of Rainfed Agriculture

S Nedumaran

One of the most important challenges faced by the humanity in the context of population explosion in the developing countries is poverty, food insecurity and waterscarcity. Agriculture around the world is predominantly rainfed, practiced on 80% of the world's land area and generating around 70% of the world food staples (Sharma et al, 2010). Rainfed agriculture is being practiced in the developed world while the developing world adopts agriculture through irrigation. If in the future if food security of the all the regions is to be ensured, there can be no such reliance on a single method of agriculture be it developed or developing world. Both irrigated and rainfed agriculture contributes equally to the food production in the present and the same could be expected to continue in the future. The projections of future demand for food grains have shown that there will be huge production deficits in food grains, cereals, oilseeds and pulses. Rainfed agriculture along with irrigated agriculture has the potential to produce sufficient amounts of food to ensure the food security of the world in the future. However, the potential of rainfed agriculture to produce competitively warrants a fresh reassessment.

According to the estimates the area share of global rainfed croplands in agriculture stood at 1.75 billion habythe end of the last millennium. This is approximately 5.5 times of the world irrigatedarea (Rosegrant et al, 2002).Due to better and reliable rainfall patterns and good management practices in the developed countries, the yield levels from rainfed agriculture have been higher. The share area of rainfed agriculture in the overall global cereal production at present is 69%, 40% for rice, 66% for wheat and 82% for maize. The global rainfed cereal yield (2.2 m tons)is 65% of that of the irrigated yield. According to the IFRI's impact water model projections, rainfed agriculture would continue to play a major role in cereal production on par with that of irrigated agriculture. On an average, the rainfed cereal yield in the developed countries stood at 3.2 metric tons per hectare and has been projected to grow at a rate of 3.9 metric tons per hectare between 2000-2025 (Rosegrant et al, 2002).

Developed countries mostly in tropical and humid climatic regions depend on rainfed agriculture largely due to reliable rainfall regimes. Whereas, in the developing countries irrigated agriculture is practiced to a large extent due to uncertainty in the rainfall regimes. Also, agriculture in the developing countries is characterized by traditional agricultural practices, lower adoption of improved varieties and poor management practices. In addition to these, as a result of low land and labour productivity, rainfed yield levels in the developing countries are very low compared to that of the developed countries. Most of the research in agriculture in the developing world has concentrated on increasing the irrigated yield levels thus far and there have been very insignificant investments in rainfed agricultural areas if any. The yield gap analysis for rainfed crops in the developing world have revealed that large yield gaps via actual realized yield of 1 -2 tons/ha compared to attainable yield of more than 4tons/ha in these areas (Bharat et al, 2010).The large yield gaps are suggestive of the scope for achieving higher gains in food production via improvements in the productivity of rainfed agriculture.

Rainfall is a random input and its variations are high in the dependent areas.Rainfed agriculture in regions characterized by erratic rainfall is subject to large inherent water related risks. As against the common perception, deficit rainfall /absolute scarcity of water is not the key issue that needs to be addressed to increase the productivity of rainfed agriculture in the developing countries (Rockstrom et al, 2009). Rather, it is the water management practices that need the attention of the policy makers, since in reality it is not the amount of rainfall that limits the production in most of the regions but it is their variability which is having an impact on the productivity of rainfed agriculture in most regions. In this context, it is pertinent to distinguish between dry spell and drought. While dry spell refers to the absence of rainfall during 2-3 weeks of critical plant growth, drought refers to the absence of rainfall for long periods of 5-10 years. While the impacts of dry spells can be reduced or completely mitigated through better soil water management techniques no such options exist for tackling drought, which requires social coping strategies on a large scale. Thus, crop failures commonly blamed on drought/dry spell could be prevented and in many cases avoided through better on-farm level water management techniques. Besides water, there are many other factors that limit the productivity in rainfed areas.Since rainfall is the prominent random parameter which is beyond the farmers' control

the inherent risks associated with water, limits the farmers from making investments in other mitigating factors that might affect productivity.

Given below are some steps which could help in enhancing the rainfed productivity particularly in the developing countries. These steps may bridge the afore-mentioned yield gaps and thus ensure food security.

- The risks associated with rainfed agriculture could be lowered by making investments to enhance soil and water conservation (Rockstrom et al, 2009).
- Water has primarily been viewed as an in situ moisture management i.e. maximizing the rainfall infiltration through moisture conservation techniques rather than managing water resources to bridge the gap resulting due to periodical scarcity. This issue could be addressed by having better water management policies in rainfed areas (Rockstrom et al, 2009).
- The ineffectiveness of rainfed agriculture in many places stems from land degradation and poor soil nutrient availability. In such cases, making site specific macro and micronutrient amendments are found to have significant positive impact on increasing rainwater productivity and thus generating higher yields. There is a need for a paradigm shift from the traditional nutrient management practices to integrated genetic and natural resource management (IGNRM) which offers integrated solutions by combining genetic, management related and socio-economic components (Wani et al, 2009; Venkateshwaralu et al, 2012).
- At present there exists an artificial divide between water management for irrigated agriculture (blue water management) and rainfed agriculture(green water management). Most of the currently practiced water management measures are blue water management techniques while hardly any attention has been given to green water management techniques. Such a policy divide has to be broken wherein equal importance is given to both blue and green water management techniques.There must be an improvement in the scope of the presently followed water resource management (WRM) techniques under an enlarged umbrella of integrated water resource management (IWRM), renewed importance being given to water use efficiency at all levels (Rockstrom et al., 2009).
- Several studies in the past have revealed that good in situ rainwater conservation when complimented with other external measures

like soil water conservation, result in significant yield increases and related increase in the rainwater productivity. Some of the in situ water conservation techniques that have been very effective include terracing, construction of bunds, ridges and other micro basins. (Venkateshwaralu et al., 2012; Wani et al., 2009)

- Conservation agriculture is yet another strategy to enhance yields via improvements in soil productivity and moisture conservation. Conservation agriculture, an in situ water harvesting technique, encompasses a range of non-inversion techniques used in combination with mulching to improve the organic water of the soil. Yield gains also become possible due to practices such as replacement of plowing by techniques such as sub soiling and ripping. Deep ripping helps in breaking the hard and compacted layers of soil and thereby increases the porosity of soil resulting in increased infiltration of rainwater into the soil. The resultant yield gains attainable will range between 20-120% and enhancement of rainwater productivity range between 10-40%.The suitability of all types of soil for the practice of conservation agriculture and their relative lower investment requirements makes them promising options for upgrading rainfed agriculture in the future. (Rockstrom et al., 2009, Wani et al., 2009).
- At present there is wasteful loss of rainwater through evaporation, which needs to be converted to effective transpiration. This could be achieved by making appropriate investments in improving soil fertility which in turn is found to increase the green water productivity.
- At present a number of fragmented watershed programs are being used to increase water productivity. However, if the actual benefits are to be reaped, synergies from all of these have to be capitalized on, through adoption of cooperative and collective watershed management programs via cross scale interaction from household till catchment scale. Watersheds should be developed as business models through public private partnership and these have to be linked to markets. (Rockstrom et al, 2009)
- An integrated analysis of water resources across scales will illustrate interesting win-win opportunities between upstream green water investments and implications for downstream water uses.
- Rather than trying to ensure sufficient water supply throughout the entire growth period of the plant, the emphasis now has to be to

enhance the productivity of rainfed agriculture. This must ensure the water to bridge the dry spells and thereby increase agricultural and water productivity through new and innovative water management techniques. This has to be facilitated through conducive institutional and policy interventions.(Rockstrom et al, 2009).

- Supplementary irrigation to crops through an ex situ water harvesting system to provide water during periods when rainfall is insufficient, to provide essential soil moisture. Construction of storage structures for conservation of water will reduce the runoff from the farm fields there by reducing the risks associated with rainfed agriculture, and trigger the untapped potential for increasing the rainwater productivity. This technique of reducing the risks associated with rainfed agriculture has shown to stabilize yields. A key advantage of this technique is its affordability by small scale farmers which makes it more attractive. Previous studies have shown that supplementary irrigation has the potential toproduce more than double yields through improved water productivity (Sharma et al.,2010; Haddad et al., 2011)
- In the phase of increasing uncertainty due to impacts of climate change on rainfall patterns, productivity enhancements through use of biotechnology, targeted research and adoption of high yielding seed varieties and better public private partnership for agricultural extension activities have been advocated.

In a world thus faced with the challenge of increasing water and food insecurity, designing policy for sustainable economic development becomes a herculean task. Policies in the past that have concentrated on increasing investments in irrigation alone as a means of securing food security no longer seem to be relevant as increasing investments in irrigation have started to yield lower marginal benefits. On the other hand, increasing investments in rainfed agriculture are found to be yielding higher marginal returns. Thus, maintaining the functionality of the existing irrigation infrastructure and reliance on sustainable rainfed agriculture seem to be sensible options for ensuring the future food security of the world and for the economic development of various countries across the globe. Thus it has become clear that concerted action by farmers, researchers, policy makers and the use of better technological innovations, biotechnology and adoption of better management practices are required to meet the future food and feed demands.

References

Roségrant M, Ximing Cai, Claine Sarah and Nakagawa Naoko. 2002. The Role of Rainfed Agriculture in Future Food Production. Working paper 90. Washington, USA, IFPRI.

Cooper R, Rao KPC, Singh P, Dimes J, Traore PS, Dixit P and Twomlow SJ. 2009. Farming with Current and Future Climate Risk: Advancing a Hypothesis of Hope for Rainfed Agriculture in the Semi-Arid Tropics. Journal of SAT Agricultural Research 7.

Venkateshwaralu B and Prasad JVNS. 2012. Carrying Capacity of Indian Agriculture: Issues Related to RainfedAgriculture. Current Science 102(6).

Johan Rockstrom, Louise Karlberg, Wani SP, Jennie Barron, Nuhu Hattibu, Theib Oweis, Adriana Bruggeman, Jalali Farhani and Zhu Qiang. 2009. Managing Water in Rainfed Agriculture: The Need for Paradigm Shift. Agricultural and Water Management 97:543-550.

Al bakri Jawad, Suleiman Ayman, Abdulla Fayez and Ayad Jamal.2010. Potential Impact of Climate Change on Rainfed Agriculture of a Semi-Arid Basin in Jordan. Physics and Chemistry of Earth 35:125-134.

Sharma Bharat R, Rao KV, Vittal KPR, Ramakrishna YS and Amarasinghe U. 2010. Estimating the Potential for Rainfed Agriculture in India: Prospects for Rainwater Productivity Improvements. Agricultural Water Management 97: 23-30.

Haddad Nassri, Duwayri Mahmud, Oweis Theib, Bishaw Zewdie, Rischkowsky Barbara, Hassan Aden Aw and Grando Stefania. 2011.Food Security 3(Suppl 1):S163-S173.

Wani SP, Rockstrom Johan and Oweis Theib. 2009. Rainfed Agriculture: Unlocking the Potential. Pages: 17-33 in Rainfed Agriculture: Past Trends and Future Prospects. Wallingford, UK: CAB international.

Some Reflections on Priority Assessment in International Agricultural Research

Jim Ryan

Introduction

Like Ma. Cynthia Bantilan, I have spent a considerable part of my professional career conducting research on impact and priority assessment of agricultural research and have used the results as a manager, at both the national and international levels. My association with Ma. Cynthia goes back 30 years, to when I joined ACIAR in 1983. Hence it only seems appropriate that I reflect on some of these international aspects. She has been involved in all the three levels as I have, namely the international research institute, funding agency and global perspective, as described in the following sections. As we celebrate her career on the occasion of her three score birthday, it is apposite that I dwell on my experiences at all these levels.

Ma. Cynthia is one of the most dedicated and conscientious professionals I have had the pleasure of working with. She is an outstanding team leader, as is illustrated by her work in the Philippines on the ACIAR/BAR project, as well as during her tenure at ICRISAT. That, along with her husband Jun, she has raised three exceptionally talented boys, both academically and musically, is testament to her unwavering devotion to family. I trust she enjoys my reflections, many of which are drawn from work that involved her.

An International Research Institute Perspective

ICRISAT was established in 1972 with a mandate for four commodities and an agro-ecology. Sorghum, millets, pigeonpea and chickpea were the initial four commodities chosen for the crop improvement program and groundnuts were added in 1974 (see Bunting et al.1974). The semi-arid tropics (SAT) were to be the primary focus of the research on farming systems, which was also where much of the production of the five mandate crops was, but by no means all of the production was concentrated. Also the SAT had many other commodities in the key production systems. This lack of congruence between the commodity and agro ecological mandates of the institute would prove to be a perennial issue in formulating strategies and priorities.

With a mandate of five crops and an agro ecology both spanning several continents, there was from the outset considerable attention paid by the Board and Management to setting priorities among these in a consistent and systematic manner. As a result the economists were called upon extensively to provide information, analyses and guidance to this process. One of the first papers was an assembly of basic information on the semi-arid tropics and the mandate crops (Ryan, 1974). This was followed by a simple congruence analysis (Ryan, 1978) as an input into the formulation of institute strategies and priorities in preparation for its first Quinquennial Review by the TAC.

The issue of the regional balance in the staffing pattern began to emerge during and after the review and in particular the appropriate share for India versus West, Southern and Eastern Africa and Latin America. Related to this was the question of research infrastructure and facilities. The ICRISAT Centre campus in India took shape by around 1980 and the expectation at that time was that this would serve as the research hub for the 49 countries with SAT environments and/or for those who grew the mandate crops. This was predicated on the notion that the experience of the Green Revolution in rice and wheat could be replicated; namely that spillovers from a wide adaptability could be exploited from India. Additionally, with an abundance of low cost skilled Indian scientists to draw upon to help staff the Centre, such a strategy was viewed as very cost-effective. To the contrary, Sub-Saharan Africa (SSA) was not well endowed with skilled scientists and NARS infrastructure was often non-existent in its SAT environments.

As an input into the decisions about regional foci and the need to consider the value and desirability of enhancing ICRISAT's presence in SSA in particular, a paper was prepared for consideration of the Program Committee of the Governing Board (von Oppen and Ryan, 1981).[1] The paper employed a modified congruence approach that examined the relative importance of the various SAT geographic regions and the mandate commodities, with the then allocation of staff resources.[2] The need to reconsider a balance in favour of a more uniform spread of ICRISAT's resources across the regions (than was the case in 1980) was suggested in this analysis. This was reinforced by the growing realisation that, unlike the more homogeneous irrigated and assured rainfall environments that allowed spillovers to be fully exploited in the Green

[1] The paper was subsequently revised and published as von Oppen and Ryan (1985).

[2] This was a relatively novel analysis in the CGIAR at that time in linking priorities to indicative resource allocations. This subject remains an elusive one for economists and the CGIAR, even today. More will be said about this later in the paper.

Revolution in rice and wheat, in the rainfed SAT biotic and abiotic, heterogeneity was the rule. This was exemplified by the experience with breeding for downy mildew resistance in pearl millet. The resistant lines developed in India did not with stand what turned out to be the different races of downy mildew found in SSA. This cast considerable doubt about the ability of ICRISAT to exploit wide adaptability concepts in the SAT with the mandate crops. In their concluding remarks von Oppen and Ryan (1985, p. 261) indicated that:

> "There seems to be increasing evidence from accumulating research experience that it may be difficult to develop improved cultivars at ICRISAT which will have wide adaptability across the SAT. Variations in day length, growing season, temperature, pests and diseases seem to preclude this. If this is true, it means that to adequately serve the other major regions of the SAT and to increase the probabilities of success may indeed require more regionally-focussed research activities……..We acknowledge the importance of technical and scientific considerations in determining any regional devolution strategy, even though we have emphasized the potential role of socioeconomic factors… It may even be true that the "optimum amounts" of centralization and devolution are commodity- and/or problem-specific".

Another feature of the von Oppen and Ryan (1985) paper was the broadening of the congruence concept to embrace emerging concerns about the poor amongst the donor community.[3] Hence in addition to efficiency criteria such as population and the gross values of production, equity indicators such as per capita incomes and nutrient and food consumption were included and various composite priority indices were constructed using different weights on equity versus efficiency criteria. The regional priority indices for each mandate crop were then compared with the current scientific staff allocations to inform future regional staffing strategies at the margin.

In 1991 a more systematic priority assessment exercise began at ICRISAT involving participatory ex ante multi-objective impact assessment and priority setting at the program/project levels, creating extensive connectivity of institute scientists and the NARS. It was a bottom-up approach as opposed to the more top-down congruence approaches that preceded it. It resulted in a priority ranking of some 110 prospective projects being considered in the context of a medium-term plan, with indicative resource requirements arrayed alongside, so that one could

[3] Indeed such issues had emerged much earlier and were addressed conceptually by Binswanger and Ryan (1977).

assess how far one could go down the list by comparing cumulative resource requirements with indicative institute funding levels. Again this was a novel approach of linking priority assessment with indicative resource allocations. This is something that ought to be revisited by the IARCs and the CGIAR as they continue to refine the Strategy and Results Framework. At present there seems to be no mechanism to do this. The framework used in ICRISAT's 1994 Medium Term Plan was subsequently published by Kelley, Ryan and Patel (1995).

As a further measure to endeavour to institutionalise priority assessment and make it a learning experience and not an episodic one (in response to donor imperatives as it often is), ICRISAT began to follow up its 1994 exercise. It linked its growing emphasis on ex post impact assessment with continuing validation of the key inherent parameters used in the participatory ex ante impact assessments for the 1994 Medium Term Plan. Ma. Cynthia Bantilan led this process after she joined ICRISAT in 1992, building on her wealth of prior experience as the leader of a major priority assessment exercise in the Philippines. This was conducted in collaboration with Jeff Davis and the author, both of whom were the then staff of ACIAR. A paper was prepared by Bantilan and Ryan (1996) which began to compare ex ante and ex post impact parameters such as adoption rates and levels to gauge how they might be modified in future priority assessment exercises. An interesting outcome of this analysis was it seemed, in the ex ante impact assessments used in the 1994 Plan, that most program scientists were either realistic or pessimistic about likely adoption parameters, except those in the chickpea program, who were invariably overly optimistic. Hence one conclusion was that in the next round, one would look more carefully and/or discount some of the adoption parameters being suggested by that program. One conclusion from this is that such continuing validations should be an integral part of the learning experience in the reformed CGIAR, especially once the Strategy and Results Framework is further refined in the manner suggested earlier.[4]

Ma. Cynthia, Jeff Davis et al. are now building upon the past work at ICRISAT and in ACIAR to revisit the spillover concepts and operationalize them in such a way that commodity and regional priorities can be further refined (Bantilan and Davis, 1991). In this process it is hoped that it may not only provide new insights for ICRISAT, but serve as a model for the CGIAR as it advances the Strategy and Results Framework. However, both would be well advised to give greater consideration as how best to link priorities with indicative resource allocations. Unless this is evident,

[4] The papers in the edited volume by Raitzer and Norton (2009) provide a valuable input into designing a more systematic approach to the revision of the Strategy and Results Framework.

there is a risk that, as is currently the case, resource allocations to CRPs will continue to essentially reflect historical allocations based on recent triennial budgets of participating IARCs. One would expect a truly reformed CGIAR to avoid a "business as usual" posture that this type of outcome would suggest. Looking at CRPs such asDryland Cereals and Grain Legumes, it appears that no serious attempt has been made to revalidate resource allocations among the constituent commodities after the IARC programs have been amalgamated and reformulated into the CRPs concerned. A quick and cursory congruence analysis by this author has revealed this. Such a revalidation must occur in the context of further development of the Strategy and Results Framework.

A Funding Agency Perspective

The focus here will be on ACIAR as a funding agency in the Australian aid program. In that sense it is a "demander" of research outcomes and impacts. This contrasts with the perspective of a research institute like ICRISAT (in the previous section) that is a research "supplier" of outcomes and impacts. ACIAR has a multi regional and multi-country perspective and was established in 1983.

As a new organization, the Board and Management of ACIAR was keen to ensure that it followed a systematic approach in its priorities within the framework of Australia's aid focus on its near neighbours in the South Pacific and Asia. In emphasising a partnership approach with neighbouring countries to the mutual benefit of both the partners, and exploitation of Australia's comparative advantage in agricultural research, ACIAR therefore had to consider both partner country priorities, Australia's interests and its scientific capacity to respond. This was a challenging assignment for ACIAR and to the economists who were enlisted to try and integrate all these variables into a consistent priority assessment framework.

The result of this task was the development of an international framework to guide priority assessment at ACIAR that built upon the seminal work of Edwards and Freebairn (1984),who articulated the concept of technological and economic spillovers in a two-country trade context. The development of the ACIAR international framework was in recognition of Australia and its partner countries that were expected to benefit from projects supported by ACIAR where the total impacts were

[5] It was argued early in the process by Ryan and Davis (1988) that agricultural research priorities for ACIAR should be assessed primarily with respect to their likely contribution to economic growth. The framework that resulted, used this as the guiding principle, while arraying possible trade-offs involved in pursuing other geo-political and equity objectives.

desired to be as large as possible.[5] The latter implied that even in the selection of bilateral projects with developing countries, there should be explicit consideration given to the scope for the research outputs to spillover to other countries besides Australia and its immediate research partners.

The international framework involved the development of a multi-country partial equilibrium trade model that allowed research on a commodity in one country to spillover into others with similar agro ecologies. These research spillovers would occur with variable lags depending on assessments of conditioning factors like the strength of the NARES, and other infrastructure constraints. Productivity gains from research were translated into supply shifts from which economic surplus gains were estimated.[6] The framework and early empirical applications were published by Davis, Oram and Ryan (1987). Further refinements to the framework and extensions to the commodity coverage in ensuing years led to a template of commodity priorities that was used as a sieve when assessing collaborative project proposals in the internal review processes of ACIAR. Break-even k shift parameters which would equalise the economic surpluses were calculated across the range of commodities that were considered economically important to partner countries and Australia. These were used to group commodities in descending order of priority. In this manner a linkage was formed between priority assessment and the project evaluation and funding processes of ACIAR.

The Minister, with advice from the Board and Management, had decided on indicative ACIAR budget shares for the geo-political priority regions for the Australian Aid program, of which ACIAR was a part. Hence the framework was modified to allow regional priorities to be assessed individually, rather than on a global perspective, as would be appropriate for the CGIAR.[7] These regional analyses were used as inputs into the regular planning meetings that ACIAR conducted in partner countries. They were not used as a top-down imperative, as ACIAR always began its dialogues with partners by responding to their sense of priorities. The regional priority assessments were not only a part of the dialogue but an important one to help ensure that spilloversincluding those to Australiawere maximised as far as possible. These mutual benefits were key requirements for ACIAR in funding collaborative projects. Indeed

[6] A standardized 5% vertical supply shift (the *k* factor) was used for all commodities with conditioning factors such as infrastructure and extension capacities used to modify adoption parameters in the economic surplus calculations.

[7] The global perspective will be discussed in the following section.

it was this requirement that provided the primary motivation for the development of the international priority assessment framework of Davis, Oram and Ryan (DOR), and especially its focus on refining, extending and operationalizing the spillover concept first raised by Edwards and Freebairn.[8]

The DOR framework was further enhanced by four country case studies which employed it or the modified versions thereof. These ACIAR/ISNAR country priority assessment studies were conducted in collaboration with partners in Indonesia, Papua New Guinea, the Philippines and Thailand. A large number of ACIAR/ISNAR Project Papers were written jointly by these partners and their Australian counterparts. Ma. Cynthia jointly led the Philippines case study with Jeff Davis, which involved BAR and PCARRD. It was arguably the most successful of the four studies, although as was the case with all of them, once the key leaders moved on, the momentum was lost after a period. This inability to sustain and institutionalise research priority assessment seems to be a feature at all levels discussed in this paper.[9] The seminal paper on spillovers by Bantilan and Davis(1991) grew out of the Philippines study and was published in the ACIAR/ISNAR Project Paper series.

A Global Perspective

A variant of the DOR framework was developed by Ryan and Davis (1990 and 1991) for the consideration of TAC of the CGIAR, as it was conducting its periodic strategies and priorities exercise. It provided both a global perspective of commodity priorities and several regional perspectives based on the TAC's continental agro ecological regions (CAERs). The latter were considered important for the assessment of priorities in sustainable farming systems and resource management research in an eco-regional context, a theme of increasing importance in the CGIAR at the time. The former of course were important for crop improvement priorities. The innovation in the papers was that it provided a way of comparing "apples with oranges" for the first time. Namely, one could view farming systems/sustainable resource management research as potentially impacting on either or both current and future commodity productivity by using an aggregation of the major commodities in the farming systems concerned as the beneficiaries of such research.[10] These benefits would be comparable to those used for commodity improvement research in the DOR framework.

[8] Jeff Davis and Ma. Cynthia were instrumental in this latter process, which continues today.
[9] Davis and Ryan (1987) discuss these issues.

Unfortunately TAC decided not to espouse the Ryan-Davis variant and instead developed a somewhat mathematical spread sheet approach to priority setting (Gryseels et al. 1992). This elicited much criticism.The TAC framework emphasized demand-side factors, whereas the Ryan-Davis variant incorporated supply-side considerations that can illustrate the likely benefits that can flow from alternative research investments (Mc Calla and Ryan, 1992). The latter is a current imperative for the impact/results orientation of the reformed CGIAR. The Ryan-Davis variant of the DOR framework, suitably modified, can and should be considered by the CGIAR as it continues the challenge of revising the Strategy and Results Framework (SRF). The excellent work being currently undertaken by Ma. Cynthia, Jeff Davis and their colleagues at ICRISAT can be extended beyond the two CRPs that ICRISAT is leading, to embrace the whole CGIAR CRP portfolio. It could result in graphics like Figures 2-6 in Ryan and Davis (1991, pp.23-27) that provide a mechanism of linking resulting priority assessments and current resource allocations to facilitate adjustments to the latter at the margins.[11]

Alternatively, the CGIAR could utilise the framework of Kelley, Ryan and Patel (1995) in the Strategy and Results exercise, where the 15 CRPs are subjected to *ex ante* impact assessments and arrayed in descending order of priority accordingly. A number of the larger CRPs could even be further disaggregated into sub-programs for the priority assessment. The Consortium would need to lead such a process.

Some Hardy Perennial Issues

To conclude I list, in no particular order some issues that have and continue to elude those like Ma. Cynthia who have spent much of their careers working on research priority and impact assessments:

- The difficulty of linking ex post and ex ante impact assessments in a way that better informs the process of research priority setting

[10] Sustainable resource management research that has longer term conservation benefits can be viewed in the same manner as other productivity enhancing research. Namely, successful research implies that future productivity of crops in a system relying on natural resources like soils and landscapes would be higher than they otherwise would be without the research. Hence the aggregated expected increased productivity can be factored into a DOR analysis in the same way that individual crops are when considering breeding research.

[11] Experience suggests that if priority assessments like those discussed in this paper are to have an influence on decision-makers, they must result in easily digested graphics like these or the box diagrams in Ryan and Davis (1988, p. 20 and 1990, pp.25-26). Of course decision-makers must also be involved in the process of developing the priority assessment framework such that it is not a "black box" to them and meets their objectives and information needs (Ryan and Davis, 1990).

and the associated allocation of scarce research resources. Can or should the former provide validations of earlier assumptions about key parameters such as adoption rates and levels for future ex ante impact assessments and priority setting? Related to this is the question as to whether sizeable documented ex post impacts imply that, more or less priority should be accorded to the same themes in future. In other words, is there a "research production function" that exhibits either increasing or diminishing returns to further investments on a given theme? Perhaps even negative returns? How can we know this a priori?.[12] At present ex post impact assessments are mostly used only for accountability purposes to funders and not explicitly inex ante priority assessments.

- In the DOR framework and its current refinement underway at ICRISAT by Ma. Cynthia, Jeff Davis and their colleagues, spillover concepts are being further developed and refined, which is welcome. However the empirical applications that are currently underway only examine them by commodity and agro ecology. Whilst it is an admittedly more challenging task, it is desirable to further disaggregate spillovers by theme within each commodity and agro ecology, as was done implicitly in the earlier ICRISAT exercise described in Kelley, Ryan and Patel (1995).
- The increasing emphasis on partnerships in international agricultural research makes attribution in impact assessment more difficult. This will especially be the case with the new emphasis on often large and complex CRPs in the reformed CGIAR portfolio. Funders will need to accept that individual institutions in future may not be able to clearly claim credit for specific impacts. Even if funders do accept this, it will remain a challenge for individual institutions to justify particular core funding levels to enable a minimum critical mass of scientific resources, both physical and human.
- Poverty alleviation has become a primary objective in the CGIAR and the donor community which supports it. How to factor in this concern explicitly in a research priority assessment context remains elusive. An often forgotten rationale for a focus on economic surplus in impact assessments is that it represents new income streams available to both poor and non-poor consumers and producers. How to ensure it is the poor rather than the non-poor who largely benefit is moot.[13] The CGIAR has primarily focussed on the staple food crops, which mostly are grown by poor and small farmers. They also represent the bulk of

[12] Binswanger and Ryan (1977, pp.220-221) discuss these issues.

the consumption expenditures of the poor, whether they be in urban areas, are landless in rural areas, or consume most of their production as small farmers. Hence the price arresting or reducing effects of research arguably represent the most important and pervasive contribution of research to the poor. Using indicators such as the number or share of poor in a region as a guide for allocating research resources may not guarantee maximum impacts on the poor. What poor small farmers may gain as producers and consumers in such regions may be dwarfed by the opportunity costs of lost marketable surpluses from more affluent farming regions that reduce prices for poor consumers outside of such regions.

- Related to the poverty alleviation imperative is the current emphasis in many of the CRPs on innovation systems and value chains as means of bringing poor small farmers out of poverty. It is not clear to what extent such an emphasis will benefit the poor, especially poor consumers, or what the comparative advantage of the CGIAR is in value-addition research or market-oriented development. Value-adding means higher prices almost by definition, and a priorithis can not be to the benefit of the urban poor, and maybe not even to poor rural net buyers. For example it may well be that value-adding innovations such as sweet sorghum for ethanol may be of significant benefit to middle-people rather than to smallholders or women. However these are researchable questions that deserve to be prominent components of the research agenda of the CRPs concerned.They should start with the seminal work in Australia on these issues by Freebairn, Davis and Edwards (1982),and Mullen et al.(1988, 1989). These found that cost-saving research beyond the farm gate often does not benefit farmers and can have unintended consequences. The distributive effects depend on many factors, including elasticities of farm and retail demands, their relation to supply elasticities and elasticities of factor substitution all along the production to market chain.
- Additionally value chain analysis might prove to be very location specific that IPGs will be difficult to generate. The proponents need to consider this more explicitly in deciding on which value chains to select for intensive research. The approach suggests that the

[13] The literature does indicate that agricultural R & D leading to productivity gains and economic growth is one of the most cost-effective ways to reduce poverty (Ryan, 2004). Hence emphases on economic rates of return and benefit/cost indicators in *ex post* impact assessments are in fact a necessary component of poverty alleviation focus. The larger these economic impact indicators are the larger the contribution to economic growth and hence poverty alleviation.

"structure, conduct and performance" paradigm, popular with market economists in decades past will be at the forefront of the value chain analyses in CRPs. It is doubtful if the CG could or should be leading this drive.

- The aspect of sustaining and institutionalising strongly linked ex ante and ex post impact assessments with priority assessments remains a problem. The experiences of research agencies at all levels bear this out. For example it has not happened either at BAR in the Philippines, ACIAR, ICRISAT or the CGIAR despite the best efforts of Ma. Cynthia, Jeff Davis and yours truly.[14] The papers in the volume edited by Raitzer and Norton (2009) explore these issues in more detail.
- There is scope to incorporate farming/production systems and sustainable resource management research opportunities into priority assessment frameworks that until now have mostly been used to assess commodity priorities. Variants of the Davis and Ryan (1991) or the Kelley, Ryan and Patel (1995) frameworks could be employed with advantage here by the CGIAR as it reconsiders the Strategy and Results Framework.

References

Bantilan MCS and Ryan JG. 1996. Using Impact Assessment in Research Priority Setting: Developments at ICRISAT. Paper presented at the International Conference on "Global Agricultural Science Policy for the Twenty-first Century", Melbourne, Australia, 26-28 August 1996.

Bantilan MCS and Davis DJ. 1991. Across-commodity Spillover Effects of Research and Opportunity Costs in a Multi-product Production Environment. *ACIAR/ISNAR Project Paper No. 30*. ACIAR, Canberra and ISNAR, The Hague.

Binswanger HP and Ryan JG. 1977. Efficiency and Equity Issues in Ex-Ante Allocation of Research Resources, *Indian Journal of Agricultural Economics*, Vol. 32, No. 3, Jul-Sep.

Bunting AH, Gregory WC, Maouboussin JC and Ryan JG. 1974. A Proposal for Research on Groundnuts (Arachis) by the International Crops Research

[14] It is notable however that ACIAR reviews adoption outcomes some years after the completion of projects as a prelude to later *ex post* impact assessments, as well as to inform current priorities but not in a systematic fashion. ACIAR also now randomly selects completed projects for its *ex post* impact assessments, which provides arguable the preferred way to facilitate linkages between *ex ante* and *ex post* impact assessments and priority setting. Cherry picking candidate projects for *ex post* impact assessments might be preferred for satisfying the accountability imperative, but not necessarily so for priority setting purposes, where both successes and failures need to be documented and understood.

Institute for the Semi-Arid Tropics, ICRISAT, Patancheru, A.P. 502 324, India, Mar.

Davis JS and Ryan JG. 1987. "Institutionalization of Agricultural Research Priority Assessment: An Application". Paper presented at Rockefeller Foundation Conference on Allocating Resources for Developing Countries Agricultural Research. Bellagio, Italy, July 6-10.

Davis JS, Oram PA and Ryan JG. 1987. Assessment of Agricultural Research Priorities: An International Perspective. Australian Centre for International Agricultural Research, *Monograph No.4* in collaboration with the International Food Policy Research Institute, Washington, D.C. Canberra.

Edwards GW and Freebairn JW. 1984. The Gains from Research into Tradeable Commodities. *American Journal of Agricultural Economics,* 66 (324) pp.41-49.

Freebairn, JW, Davis JS, and Edwards GW. 1982. Distribution of Research Gains in Multistage Production Systems. American Journal of Agricultural Economics, 64 (1) pp. 39-46.

Gryseels G, De Wit CT, Mc Calla A, Monyo J, Kassam A, Craswell E and Collinson M. 1992. Setting Agricultural Research Priorities for the CGIAR. Agricultural Systems, 49 pp.59-103

Kelley TG, Ryan JG and Patel BK. 1995. Applied Participatory Priority Setting in International Agricultural Research: Making Trade-offs Transparent and Explicit. *Agricultural Systems*, 49 pp. 177-216.

Mc Calla AF and JG Ryan. 1992. Setting Agricultural Research Priorities: Lessons from the CGIAR Study. *American Journal of Agricultural Economics*, 74(5), Dec. pp. 1095-1100.

Mullen JD, Wohlgenant MK and Faris DE. 1988. Input Substitution and the Distribution of Surplus Gains from Lower U.S. Beef Processing Costs. American Journal of Agricultural Economics, 70 (2), pp. 245-254.

Mullen JD, Alston JM and Wohlgenant MK. 1989. The Impact of Farm and Processing Research on the Australian Wool Industry. American Journal of Agricultural Economics, 33 (1), pp. 32-47.

Raitzer DA and Norton GW eds. 2009. Prioritizing Agricultural Research for Development: Experiences and Lessons.CAB International, Wallingford UK.

Ryan JG. 1974. Socioeconomic Aspects of Agricultural Development in the Semi-Arid Tropics. ICRISAT Economics Program Occasional Paper 6, Patancheru, A.P. 502 324, India, Nov.

Ryan JG. 1978. Agriculture and Research in the Semi-Arid Tropics, mimeographed internal paper, ICRISAT, Oct.

Ryan JG 2004. Agricultural Research and Poverty Alleviation: Some International Perspectives. Invited Paper, for the John L. Dillon AO Commemorative Day on Agricultural Research: Challenges and Economics in the New Millennium. The University of New England, Armidale, NSW Australia on September 20, 2002 (published as ACIAR Working Paper No. 56).

Ryan JG and Davis JS. 1988. Economic Growth, Technological Change and Priority Assessment in Agricultural Research. Invited Paper for Seminar on Strategic R & D Planning and Management, Ministry of Science, Technology and the Environment, Malaysia, National Council for Scientific Research and Development, Malaysian Agricultural Research and Development Institute, Rubber Research Institute of Malaysia and Commonwealth Science Council, Kuala Lumpur, Malaysia, 8-11 August, 1988. ACIAR/ISNAR Project Paper13. ACIAR, Canberra and ISNAR, The Hague.

Ryan JG and Davis JS. 1990. A Decision Support System to Assist Agricultural Research Priority Setting: Experience at ACIAR and Possible Adaptations for the TAC/CGIAR. Invited Paper Presented to the Fifty-First Meeting of the Technical Advisory Committee of the Consultative Group on International Agricultural Research, Rome March 12-17. *ACIAR/ ISNAR Project Paper* 17.

Ryan JG and Davis JS. 1991. Assessing Agro-ecological and Commodity Priorities in International Agricultural Research. Revised version of Ryan and Davis (1990).

Von Oppen M, and Ryan JG .1981. Determining Regional Research Resource Allocation Priorities at ICRISAT. Prepared for the meeting of the Program Committee of the ICRISAT Governing Board, ICRISAT, Patancheru, AP. 502 324, India.

Von Oppen M and Ryan JG. 1985. Research Resource Allocation: Determining Regional Priorities, Food Policy, 10(3), Aug. pp.253-264.


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Importance of Spillover Impacts in International Agricultural Research

Jeff Davis

Introduction

For more than 25 years I have had the pleasure of being able to say that I have been a professional colleague of Ma. Cynthia Bantilan- Cynthia. Much of this time we have collaborated in and supported each other in quantifying the welfare impacts of agricultural research and using this analysis to support decision-making regarding agricultural research funding.

In this short note I will not focus on this major contribution to this areaas this has already been undertaken more appropriately by Jim Ryan in another note in this volume. Instead I will look at a narrower component of this overall activity – the spillover impacts of international agricultural research. In particular, the contribution Cynthia has made to a better understanding of spillovers and their importance to international agricultural research.

Discovering the Importance of Spillovers

For a long time agricultural research has been recognised as having public good characteristics, especially when an international perspective is considered. As aresult, international aid organisations have for many decades funded agricultural research as a means of improving welfare in the developing world. Cynthia has spent most of her career in supporting this international endeavour.

Despite the importance of the notion of research spillovers in achieving these impacts and the widespread use of the terminology in most discussions of international (and even national) agricultural research, surprisingly very few have a full understanding of what spillovers really mean and especially how they can be quantified.

Throughout Cynthia's impressive career which has focused on using quantification of the impacts of research to support strategic decision-making, she has strived to better understand the nature of spillovers,made

concerted efforts to quantify and use these estimates to support her view points.

Very early in this period she recognised the importance of developing a rigorous conceptual understanding of what really underlies research spillovers and providing the foundations for effectively quantifying and using them. As is always the case with the practical use of complex methods and concepts, at various stages of this empirical application, Cynthia has had to make practical pragmatic compromises. The crucial and important aspect of Cynthia's approach has been to base this practicality on a very strong conceptual foundation.

A brief overview of this conceptual understanding can be illustrated by looking at a range of papers which were produced by Cynthia during the very productive days of the ACIAR funded Research Priorities for Philippine Agriculture Project (RPAP). These papers were presented on a regular basis at professional conferences and used as underlying basis for the project activities.This underlying framework is required to ensure that: the research policy context was incorporated, Bantilan (1991); the linkages between production functions and cost structures were clearly understood, Davis and Bantilan (1991), the research process and associated risks are fully understood, Bantilan and Davis (1991); and the complexities of spillovers and opportunity costs in a multi-commodity production environment are included, Bantilan and Davis (1991). All these aspects of research impacts are very important to fully understand spillovers. Cynthia made important contributions to ensure that the mathematical relationships underlying the logic of each component were flawless.

In addition to this important conceptual contribution, she has also developed the very important skill of working closely with technical scientists to subjectively elicit empirical estimates of all components of spillover impacts. Evidence of this skill is not easily documented; however, Cynthia's capacity to do this started in the Philippine context and continued through all aspects of ICRISAT applications. The nature of Cynthia's skills in this area is best demonstrated by the very strong respect she commands from her technical science colleagues. This started with some of the most respected rice breeders in the Philippines and continues with many of the senior breeders and other scientists at ICRISAT. I believe this is a special skill which few economists develop effectively, yet is crucial while obtaining the expert judgments of scientists,and is required to estimate the important underlying components of spillover impacts. It

is also important for establishing credibility of the quantification activities and especially ensuring ownership of the whole decision support process.

Cynthia was responsible not only for the subjective elicitation of spillovers but also for some of the early efforts of validating the judgemental estimates with analysis of trial data. See for example Bantilan and Sarinas (1991).This activity has continued and has been extended to other aspects of the impacts of agricultural research (for example, estimation of the adoption of research outcomes).

Cynthia's initial rigorous conceptual enhancement to the understanding of research impacts and implications for spillovers stood her in very good stead.It ensured that the more pragmatic demands of the scoring model type priority setting activities undertaken by ICRISAT in the 1990's and early 2000's were soundly based. CGIAR criteria such as 'internationality' were general subjective notions of research spillovers. Ensuring that subjective assessment of this factor was consistent, and to ensure that double and triple counting did not occur, required a good conceptual appreciation of the complexities underlying research impacts. Cynthia's past conceptual contributions successfully provided this.

More recently the concept of international public goods and the need for the CG system to concentrate on these focused attention again on more detailed appreciation of research spillovers and a more rigorous approach to understanding the underlying concepts and complex components.

Cynthia's original rigorous conceptual contributions placed her in an excellent position to come to grips with these demands and focus attention in the right direction. This is succinctly illustrated in the review document produced to guide those addressing this new demand; see Deb and Bantilan (2001).

More recently this drive has led Cynthia to establish a team which is: developing new approaches to quantifying research spillovers internationally; more rigorously understanding this area; and using it to support international research decision-making. The ultimate outcome will be improved welfare for the developing world and world in general. This effort is highlighted in Bantilan et al (2013). This was used as the basis for a recent Workshop which assembled sixteen of the world's leading economists in research impact assessment. The Workshop reviewed the suggested developments and the expert panel concluded that the directions Cynthia and her team are developing and applying are state of the art.

Clearly this has been and is a very important contribution from a dedicated professional.

Some Future Directions for Modelling and Understanding the Importance of Research Spillovers

As is usually the case even with these comprehensive contributions the work is never finished. There is a continuing demand for enhancements, which is always fuelled by an expanding frontier of technological feasibility. While Cynthia has already identified many of the important areas for possible enhancement I will reflect on a few which I feel deserve special focus:

- Continue to develop the conceptual understanding of spillovers to enhance their empirical estimation. Dissect rigorously the linkages between research applicability among different environments, the underlying production and costs structures and adoption. These components are intertwined and in many cases the current reduced form of understanding the linkages, misses several important issues and implications.
- Improve the linkage between ex post and ex ante assessments of research impacts to better understand spillovers and more effectively quantify them. This especially means matching the subjectively elicited assessments of research applicability for different production environments with the observed impacts for specific technologies which have had an impact. In particular to clearly separate whether any observed differences are due to the need for more rigour in the elicitation process or the need to more clearly understand the underlying differences between applicability and farmer adoption. There is a need to better understand and measure the cost (unit cost reduction) impacts of research as well as relate, how these link with spillovers. To determine which is the best way to effectively estimate these for actual technologies and whether this provides an effective guide on how best to achieve this for ex ante activities. For example, are expert judgments more effective than detailed surveys and do the conceptual and empirical research on frontier production (and associated cost functions) have a contribution to make?

To effectively address and contribute to these important aspects of achieving and better understanding spillovers it will be crucial to ensure that much of Cynthia's past contributions are synthesised, expanded and

published in readily available documents. I can hear Jim Ryan saying 'here here'!!

Some Personal Notes

On a personal note I have very much appreciated and enjoyed my professional interactions with Cynthia over the last three/four decades.

Cynthia's work ethic has been second to none of my professional colleagues. I cannot help but reflect on the early days when the RPAP project was in full swing receiving an update on a weekly project meeting and noting that it was held around Cynthia's bed in the maternity hospital the day after her and Jun's third son was born! I still try to picture the team of 16 all around the bed discussing the work achievements and plans. Even in her 60th year, I am amazed that emails arrive with sent times of all hours of the night. She continues to take on a workload which most would not be capable of nor tolerate.

I am indebted to Cynthia for a much appreciated 'cultural' education. As is the case with most Australians I suffer a personality trait of extreme bluntness! I was very fortunate in my early days with ACIAR, to work with Cynthia who was very tolerant of my early 'behaviour'. She later confessed that having studied with two Australian graduate students for three years in the US had a significant spillover benefit for me. They made her realise that long term gains can be achieved from early tolerance of the Australian personality. I am sure that this initial spillover to me has also spilled further via my improved ability to work more effectively with many colleagues in many countries and probably even improved my ability to work with other Australians! I will leave it to Cynthia (and others) to assess whether I really did learn much but at the least I feel, I did! Thank you very much.

Finally, I am very grateful for the friendship that has developed between our two families. It has been very interesting following each other's children's development. It was not at all a surprise for me to see the very impressive academic success of your three boys. I suppose if a baby shares his first meal table with 16 economists' discussing research priorities it is not a surprise that some academic stimulation would result! It is very pleasing that Pat has recently been able to share this friendship and we hope that as retirement draws closer we can share more social activities with you, Jun and the rest of your family.

References

Bantilan MCS. 1991. Agricultural Research Policy Issues and Process of Formulation. ACIAR/ISNAR Project Paper No. 35, Philippine Country Study.

Bantilan MCS and Davis JS. 1991a. Research Production Function and Probability of Success in Agricultural Research Evaluation. ACIAR/ISNAR Project Paper No. 31, Philippine Country Study.

Bantilan MCS and Davis JS. 1991b. Across-commodity Spillover Effects of Research and Opportunity Costs in a Multi-product Production Environment.ACIAR/ISNAR Project Paper No. 30, Philippine Country Study.

Bantilan MCS, Nedumaran S, Mausch Kai, Kumara Charyulu D, Kamanda Josey, Ndjeunga Jupiter, Deb Uttam, Mazvimavi Kizito and Davis Jeff. 2013. Impact Assessment Analysis to Support International Agricultural Research Funding Decisions: Historical Overview, Methods and Applications at ICRISAT. Paper for Pre-Conference Workshop, AARES Conference, Sydney, Australia, February.

Bantilan MCS and Sarinas. 1991. Trail-based estimates of spillover effects of research across production environments in Philippines. Research Priorities in the Philippines Agriculture Project (PN8624). Unpublished ACIAR Paper.

Davis JS and Bantilan MCS. 1991. Agricultural Production Response and Cost Structures: Cost Reduction and Output Increasing Linkages for Research Impacts. ACIAR/ISNAR Project Paper No. 29, Philippine Country Study.

Deb UK and Bantilan MCS. 2001. Spillover Impacts of Agricultural Research: A Review of Studies. Working Paper Series No 8, ICRISAT, Patancheru, Andhra Pradesh, India.

Chickpea Revolution in Andhra Pradesh, India

D Kumara Charyulu

Chickpea (Cicer arietinum L.) is the largest pulse crop grown in India and the third largest food legume in the world. It occupies around 15% of the total pulse area globally and is cultivated in almost 52 countries (FAOSTAT, 2012). South and South East Asia (SSEA) alone contribute about 88% and 86% shares in global area and production respectively. Chickpea is highly nutritious with 20-22% protein, rich in fiber, minerals and beta carotene. Chickpea haulms are used as animal fodder and they are more nutritious in comparison to the cereal fodders. Chickpea cultivation helps in fixing atmospheric nitrogen and contributes to the buildup of organic matter in the soil. There are two types of chickpea-desi (with dark colored seed coat and smaller in size) and Kabuli (with white or cream colored seed coat and larger in size). In India, desi varieties account for 80% of production and Kabuli varieties contribute the remainder.

India ranks first in chickpea production and consumption in the world (both accounting to almost 70%). Currently, chickpea covers 35% of the total pulse area and contributes to nearly 47% of total pulse production in India (GOI, 2012).The linear trend line computed for productivity for the period, 1950-51 to 2010-11, indicates that the productivity has increased by about 5 kg per year. Northern India, with its long winters, has suitable climate for chickpea cultivation but expansion of irrigation and high-input agriculture led to chickpea being largely replaced by wheat and other cash crops during the last four decades. During the 1964-65 cropping season, chickpea was planted on 5.14 mha in Northern India; it is now planted on only 0.73 mha (2010-11). During the same period down in Southern India, the cropped area has gone up significantly from 2.05 m ha. to 5.56 m ha. This tremendous shift in cropped area happened due to introduction of high yielding; short duration chickpea varieties that are resistant to Fusarium wilt disease.

New chickpea varieties adapted to warmer, short-season environments are bringing increasing prosperity to Southern India and offer hope for farmers elsewhere in the Semi-Arid Tropics (SAT).The six major

states of Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, Karnataka and Andhra Pradesh together contribute more than 90% of area and production of chickpea in India. However, the growth rate in area,production and productivity during the last four decades (1970-2010) is distinctly higher in Andhra Pradesh when compared to other states. The productivity in Andhra Pradesh has increased enormously from 853 kg per ha in 1996-97 to 1308 kg per ha by 2009-10 due to the widespread adoption of improved high yielding cultivars.

Chickpea was not even a minor crop in Andhra Pradesh until 1985. While short winters, terminal moisture stress, wilt disease and pod borer were the major constraints for growing chickpea in this southern state of India, there were at least three recognized advantages in chickpea crop cultivation - easy to grow, free from foliar fungal diseases, and less vegetative growth. The main reasons for farmers' preference for chickpea are that the new cultivars are short duration, less labor intensive and low investment requirement per acre. It is a less risky crop with assured yields, market and good remunerative prices, and is highly suitable for mechanical operations. Finally chickpea is highly amenable for scale up cultivation. Crops such as sorghum, tobacco, cotton, redgram, sunflower, groundnut and coriander were dominant in the early 1990s and were substituted by chickpea through time. Until late 1990s, the area under chickpea cultivation in Andhra Pradesh was only 1.52 lakh ha. It was dominated by a single largest cultivar i.e., Annegeri released in 1978 and developed by Karnataka state. The average yields of Annegeri were ranging from 600 to 700 kg per ha.

The research collaboration between Acharya NG Ranga Agricultural University (ANGRAU), Rajendranagar, Hyderabad and ICRISAT on crop

improvement and management addressed both the above constraints and developed new cultivars which could make chickpea a suitable crop for the region. The close and sustained collaborative efforts led to the development and release of short duration chickpea varieties ICCV-2 (Swetha – Kabuli type) and ICCC-37 (Kranthi - desi type) during the early and late 1990s respectively. Since then, Andhra Pradesh witnessed a notable uptake of improved chickpea cultivars and corresponding increase in cropped area. To follow this up, on-farm trials conducted in early 2000 strongly recommended the adoption of short-duration and high yielding varieties of JG-11 (desi type) and KAK-2 (Kabuli type). In addition, bulk introduction and multiplication of seed by Andhra Pradesh State Seed Development Corporation (APSSDC) was complemented by the Department of Agriculture subsidy which enabled distribution of huge quantities of improved seeds to farmers. Phenomenal increase in the chickpea area in the state was witnessed after getting access to JG-11 variety and other kabuli types. When compared to Annegeri, higher yield, bigger grain size and Fusarium wilt resistance were important traits that farmers preferred in JG-11.

The new improved cultivars have almost replaced the earlier varieties and JG-11 is the single dominant cultivar which occupied nearly 85% of the chickpea cropped area in the state during 2011-12. The state average productivity levels have gone up from 1300-1400 kg per ha. On the whole, it resulted in silent chickpea revolution in the state with the ten-fold increase in area (from 0.65 lakh ha to 6.3 lakh ha), two-fold increase in productivity(from 622 kg per ha to 1389 kg per ha) and a twenty-fold increase in productionin the state during the last two decades (1990-2010).


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Loyalty Award

Biofuels: Alternative Source of Renewable Energy

G Basavaraj

Global Energy Scenario

Energy is the elixir of economic growth. Economic growth along with increasing population and per capita income are the major drivers of energy demand. Over the past decade the global economy and population have grown at the rate of 2.7% and 1.1% respectively. The highest demand for energy across the globe comes from industry which consumes about 51%, followed by the transportation sector with 20% consumption. Globally, primary energy use remains dominated by fossil fuels (coal, oil and natural gas), which account for 75% of the total primary energy supply. Renewable energy sources, comprising mainly of biomass and hydropower contribute less than 19% of the world primary energy use of which biomass contributes around14%.

Energy from non-renewable sources being in short supply and the demand for energy is on an increasing path especially from the transportation sector, it is projected that supply can no longer be increased to meet projected demand. Hence, in lieu of the growing concerns of energy security and securing long-term supply of energy sources that are renewable and non-polluting has been the major thrust of many governments all over the globe.

Among several alternative renewable energy sources (wind, solar, hydro) energy derived from plant biomass is found to be promising and a sustainable energy source that contributes to reduction in greenhouse gas emissions and is also found to provide wide range of social and economic benefits.These liquid fuels are derived from plant biomass and organic wastes. The potential plant biomass for the production of biofuels includes sugarcane, maize, sorghum, wheat, sugar beet and cassava. The choice of feedstock for the production of bioethanol as biofuel varies across countries. If sugarcane as a feedstock has a comparative advantage in Brazil, it will be corn in America and wheat in Canada. Hence, the choice of the feedstock depends completely on

the economic considerations of comparative advantage and efficiency in production of these feedstocks for processing into bioethanol. Apart from economic considerations, environmental benefits also play a significant role in feedstock selection and processing. Sweet sorghum is one such alternative biofuel feedstock that has the potential to produce bioethanol commercially.

Sweet sorghum as a source of energy

Sweet sorghum is a C4 plant with high photosynthetic efficiency. It produces a high biomass (up to 40–50 t ha–1) in a short duration (4 months) under rainfed conditions. One advantage of sweet sorghum when compared to other crops is that using sweet sorghum for fuel does not reduce its contribution as a food source. The grain can be harvested for food, and the bagasse—the fiber that remains after the juice used for biofuel has been extracted—may be used for fodder in countries where it is an important source of livestock feed. Hence, sweet sorghum is a "smart" crop, which meets the triple requirements of food, fuel and fodder.

Globally, it is grown in about 45 million hectares, with Africa and India accounting for about 80% of the global acreage. Like grain sorghum, sweet sorghum, a warm-season crop, can be cultivated by smallholder farmers in rainfed areas. The crop can be grown successfully on clay, clay loam or sandy loam soils and can tolerate salinity and alkalinity to a large extent. Cultivation practices of sweet sorghum are similar to that of grain sorghum. The only dissimilarity between grain sorghum and sweet sorghum is seen in the accumulation of sugars in the stalks of sweet sorghum. They can be crushed to extract juice, which is finally processed into ethanol for blending with gasoline. The sweet sorghum based ethanol is sulphur free and cleaner than ethanol produced from other feedstocks.

Bioethanol production from sweet sorghum in semi–arid tropics of India

ICRISAT's biopower strategy has launched a global biopower initiative which is a pro-poor strategy. This focuses on feedstock sources and approaches that do not compete with food production but produces food as well as fuel and even enhances food production. To promote this strategy a value-chain approach of "Seed to Tank" has been adopted. This involves sweet sorghum production, processing, value addition and marketing. The value chain approach will provide greater employment

and income-generating opportunities for farmers and other stakeholders in the value chain, while supplying an environmentally friendly energy source. Sweet sorghum was initially processed into ethanol in a distillery established by a private sector partner M/s Rusni Distilleries Pvt. Ltd, located in Medak district of Andhra Pradesh. The distiller was incubated in ICRISAT's Agri-business and Innovation Platform and has the capacity to produce 40 kiloliters of ethanol per day. The relative economics of sweet sorghum cultivation and processing it to bioethanol augurs well in the agro-ecological regions of Maharashtra and Andhra Pradesh. About 57% of the cultivable area in SAT India is under rainfed conditions. Crop choices are limited for resource poor farmers under harsh environments of semi-arid regions. Dryland crops like sorghum and millet thrive under such harsh conditions. Hence, cultivation of sweet sorghum in marginal and rainfed areas of SAT regions provides opportunity for small holder farmers to enhance their incomes through cultivation of biofuel crops. Promotion of sweet sorghum through favorable polices related to production, processing and marketing and more importantly pricing will pave the way for bioenergy revolution in India through agriculture intensification in dryland areas.

Pockets of prosperity in the midst of poverty - Groundwater market induced development impacts on the small holder's farm economy in Peninsular India

N Nagaraj

Water is the elixir of dry land agriculture serving as a productive and protective resource. Groundwater as a source of irrigation is gaining prominence in water starved semi-arid regions of India. Since agriculture is heavily dependent on ground water irrigation in the dry tropics of peninsular India, informal water markets are playing a key role by expanding access to ground water for small and marginal farmers and other peasants who cannot afford to invest on wells. Water markets have thus become a key source of irrigation for many farmers for sustaining their incomes.

Importance of Groundwater markets

The literatures on impact of groundwater markets confirm that these markets are the 'vehicles of poverty alleviation'. There are those who accuse groundwater markets of 'creating water lords' and appropriating the surplus from the poor (Mukherji 2004). In some areas there are niche markets for ground water supporting small scale irrigation. These markets are imperfect since they are inter connected with labor and credit markets. In places where there are fragmented holdings and parcels of land (that are far from each other), often coupled with the surplus water in the wells, well-owners are motivated to sell theirsurplus to the neighbours (Kolavalli and Chicone 1989). Ground water markets are informal institutions providing access to ground water irrigation supporting resource-poor farmers who are constrained to invest on expensiveand risky bore well irrigation (Nagaraj et al 2005).

Focus of the study

Groundwater irrigation triggers the agricultural growth in the semi-arid water starved regions. Since the well irrigation is risky and requires sizeable lumpy investments, small and marginal farmers are constrained to invest in it. Thus, this study examines how access to irrigation through water markets enhances the livelihood security and reduces poverty for

the small and marginal farmers in the rainfed areas. This study is confined to the semi-arid dry zone of Karnataka in peninsular India where one of the VDSA villages (Tharati) is situated, 18 km from Tumkur district and 6 km from the taluk head quarters (Koratagere).

Data base

Using PRA and case study approach, the data was collected from the water sellers and water buyers. There are 48 bore-wells, 20 filter bore-wells and 43 open wells with 15 water sellers and 20 water buyers in Tharati village. The bore-wells discharge water ranging from 1500 to 2000 gallons per hr.

Backdrop of the village

The striking feature of the village is that it is land locked and surrounded by hillocks which restricts horizontal expansion.The land holdings are small ranging from 0.5 to 5 acres. Thus, the village is predominantly small and marginal farmers with agriculture and allied activities as the main source of livelihood. Landless labor households accounts for 27 % of the total 401 households. The gross cropped area in the village is about 171 ha, of which over 38 % of the area is irrigated through groundwater. The cropping pattern indicates a combination of finger millet, pigeon pea and commercial crops like flowers, areca and betel vine. Groundwater is the main source of irrigation in the village. Due to prolonged drought, the discharge of groundwater in the bore-wells has gone down drastically. The shallow bore-wells have completely dried up, leading to loss of investments. Hence, deepening of bore-wells is continuing. Due to bore-well failures and increasing scarcity of water, some of the farmers drilled deeper bore-wells (700-900ft) in the area.

Well investments

On an average, the farmers invested around Rs.2.29 Lakhs in drilling a bore-well of which the cost of exploration (drilling and casing) amounted to 44% of the total cost. The cost of extraction mechanism with all accessories (casing, pumpset, electrical fittings and storage pond) formed a major share (40%) of the capital cost. The conveyance cost (HDPE pipeline) is around 12% of the total cost. Well drilling entails huge investment besides associated risk of failure. On an average, the well investments per acre of gross cultivated area is around Rs 50,000/. Thus, high capital investment per unit area is evident.This prevents resource-poor, small, and marginal farmers from investing in bore-wells.

Annual cost of groundwater irrigation

Karnataka state provides free electricity for irrigation pump sets below 10 HP to pump ground water from farmers owned wells. Thus, the marginal extraction cost is virtually zero. However, the annual cost of groundwater for a groundwater seller represents the amortised cost of all well investments. Upon amortising the investments made on bore-wells considering a lifespan of 8 years for a bore-wellat 8% interest per annum (opportunity cost of capital), the annual share of groundwater irrigation works out to be Rs.39968. Considering gross irrigated area of 4.5 acres, the average cost of irrigation per acre of gross irrigated area works out to be Rs. 8881.

Water Markets

Incidence of water markets is not pervasive but localized. Well owners sell more water during rabi and summer than in kharif, as rainfall supplements groundwater irrigation in kharif. On an average, the seller has 3.5 acres of cultivated area, of which 55 % of the area is irrigated. On the contrary, the buyer had 2 acres of cultivable land, of which 25% of the area is irrigated through groundwater bought from the seller. In other words, for every one acre irrigated by the seller, the buyer irrigates ¼ th of an acre in all the 3 seasons. There are more water buyers than sellers. It was observed that for every one seller there are 2-3 buyers in some cases. The gross irrigated area is 4.5 acres for the sellers as against 1.3 acres for the buyers.

Factors influencing selling and buying of water

Existence of surplus water in bore-wells and extremely small holdings influence water sales. In addition to physical proximity of land, social relations between buyer and seller and the homogenous nature of the community (gardeners)influenced the sale and purchase of groundwater in the village. The water markets emerged in the village since 2002.

Water sales and rents

The major commercial crops exclusively grown by sellers and buyers of water are flower crops viz., chrysanthemum in all the 3 seasons. However, vegetables like carrot and brinjal were also grown on a small scale. Tharati is one of the model villages for flower cultivation and generates lucrative income. Since irrigation is a prerequisite for growing flowers, most of the marginal farmers buy water from their

neighboring well owners to cultivate the flower crop. On an average, the buyers cultivated 0.4 acres of chrysanthemum in each season. Farmers cultivated flowers intensively using the latest technologies, as the size of operational holding is small. On an average, 20 irrigations in Kharif, 30 in rabi and 34 in summer were given. The prevailing water rent is based on crop share contract. Water charge is around 1/3rd of the market value of the output. The gross income generated from 0.4 acres in 3 seasons (Rs. 59920+62500+60,000) was around Rs. 182,000/. Considering 1/3rd of the output value, the water rent paid to the seller was to the tune of Rs. 60,666/. Thus from the buyers' point of argument, on an average the cost incurred to irrigate per acre of flower crop is to the tune of Rs. 50,500/. In the event of crop failure, the water rent is deferred to the next crop.

Value addition to flowers

It is interesting to note that both sellers and buyers of groundwater are involved not only in flower production but also in stringing the flowers by employing family labor and hired women labor from the landless households. If flowers are sold on bulk without sorting, cleaning and stringing, it fetched around Rs. 60-70 per Kg, while sorting and stringing of flowers and selling at retail market fetched double the price. The additional cost involved in stringing the flowers is Rs.10/per kg and the resulting value addition is to the tune of Rs. 50 to 60. Thus flower production has created not only value addition but also generated additional employment for women on the farm preventing migration of labor. The agricultural growth exhibited in this village is impressive and inclusive through water markets facilitating commercial floriculture in the village.

Development pathways

The extra income generated by the water buyers through floriculture is to the tune of Rs. 149000/ per annum. These farmers are involved in 'water buying' and practicing commercial agriculture on a small scale earning lucrative income since 5-6 years. Some farmers repaid their old debts (up to Rs. 3 lakhs) out of their savings, while some invested a part of income on constructing new houses, onland development and setting up of petty business. Others invested on livestock and durable goods like, televisions, motorbikes etc. Thus the livelihood security of the poor has been strengthened due to access to water markets.

References

Kolavalli S and Chicone DL. 1989. Groundwater Markets in Gujarat, India. International Journal of Water Resources Development 5: (1): 38-44.

Mukherji A. 2004. Groundwater Markets in Ganga-Meghna-Brahmaputra Basin: Theory and Evidence. Economic and Political Weekly 3514-3520.

Nagaraj N, Suvarna Kumar AH and Chandrakanth MG. 2005. Economic Analysis of Ground water Markets in Central Dry Zone of Karnataka. Water Policy Research Highlight, IWMI.

Adoption of micro-irrigation for addressing water and labor scarcity in the Semi-Arid Tropics of India

Madhusudan Bhattarai

Introduction

Irrigation plays an important role in determining cropping pattern, cropping intensity, and land productivity. Besides market prices, farmers' choice of a crop is determined by their access to irrigation and level of control on irrigation water that can be perceived at the time of sowing the crop. In the Semi-Arid Tropics (SAT) of India, it is not the availability of land per se but the availability of water, and degree of control on access to water for the farmers, that determined their crop choices, cropping intensity, and crop productivity. Thus, better understanding on smallholding farmers' choices on adoption of different irrigation technologies, and their alternate options are critical for improving rural livelihoods in SAT India, and in dryland farming world wide.

Along with increasing water scarcity, the importance of water saving technology such as micro-irrigation is increasing across the countries, particularly in dry regions with falling water table and limited options to tap additional water resources. Farmers in the SAT India have been adopting innovations in irrigation (such as micro-irrigation) to meet their growing need for water for farming, and also tackling the water scarcity which is threatening their livelihood. They are using various forms and alternations of micro-irrigation systems (e.g., low-cost drip, high cost and high pressure drip, low cost sprinkler, high cost sprinkler), which help in increasing water use efficiency during the dry season. These will in turn increase crop productivity and farm income by helping the farmers to use the scarce water judiciously (Polak and Yoder 2006).

In this context, this paper assesses SAT farmers constraints and benefits of adoption of micro-irrigation technologies, and policy issues associated with farmers' use of the micro-irrigation technologies for increasing farm productivity and achieving the social goal of rural poverty alleviation.

Wherever good access to water and market is available, farmers grow high value crops including vegetables and other cash crops (Midmore

and Jensen 2003; Mariyono and Bhattarai 2009). So also, whenever smallholder farmers adopt such micro-irrigation systems they usually shift from cereals to fruit and vegetables or other high value crops (Polak and Yoder 2006; Palanasami 2012). They also tend to be more connected with the local markets. Therefore, adoption of micro-irrigation technology leads small holder farmers not only to grow high value crops and increase farm income, but also to link well with market network, which will ultimately lift them out of poverty in a short-span of time. Adoption of such micro-irrigation technology not only facilitates increased diversification of crops and income sources, but also makes the farming enterprises more resilient in the face of market and climate volatility (IDE 2009). In many parts of SAT India and other parts, adoption of micro-irrigation (drip and sprinkler) has led to a considerable expansion of market oriented production of cash crops (and intensive production of vegetable and other market oriented crops), and improvement in rural livelihoods (Namara et al. 2007; Bhattarai 2008; Palanisami, 2012).

Micro-irrigation technology plays a critical role in sustaining agricultural production and productivity level in India. Out of a total of 140 m ha of potential irrigated area in India, the potential of minor irrigated area is about 81.5 m ha, which is 58% of the total potential irrigated crop area in the country. Globally, in 1991, India ranked 6th position in terms of acreage of irrigated area under micro-irrigation (Palanisami, 2012). In general, micro-irrigation technologies are adopted more within the minor irrigation systems than in the canal (or major) irrigation systems.

Application of micro-irrigation systems allows for efficient utilization of the scare water resources grouped under the minor irrigation systems. So far, the utilization of minor irrigation scenario at all India level, till the 10th five year plan (2002-07), was only 72% of the ultimate potential created, and about 60% of the potential utilized (Palanisami, 2012).

In 2007, about 3.88 m ha of cropland in India was under micro-irrigation systems, which is about 10% of the total irrigated areas in the country. Growth of micro-irrigation systems is higher than that of other modes of irrigation.However, the pace of development of micro-irrigation varies across the Indian states. The crop acreage under micro-irrigation systems (drip and sprinkler) out of the total irrigated land is more in Andhra Pradesh (50.5%), followed by Chatisgarh (30%), Maharashtra (25.7%), and Karnataka (22%) (Palanasami, 2012).Both water and labor scarcity problem is high in all of these four states. Thus, micro-irrigation technologies play an important role in SAT farming and rural livelihood in

India; its importance is growing through time due to increasing scarcity of water and tightening of rural labor markets.

Micro level issues on benefits and constraints on adoption of micro-irrigation

Farmers adopt the micro-irrigation technology to save scarce water resources and to save the labor use on irrigation and other intercultural operation. Initially, the technology was promoted to save water use. However, the saving on labor has become more important in farmers' decision to adopt the technology than the saving on water application. Due to rising labor cost and tight rural labor market across India, farmers are switching from traditional flooding system of irrigation to micro-irrigation systems for irrigation.

In many places of India, increasing government support and subsidy for the drip (and sprinkler systems) are some of the motivating factors for farmers, (mostly for large farmers) to install the system on more than an acreage of land. Government subsidy is administrated through complex process, with a high transaction costs. Due to these factors, small and marginal farmers are usually out of the reach of the public subsidy.The subsidy on the technology is captured more by large farmers or well-to-do farmers of a place, who can effectively internalize high transaction costs involved in securing the subsidy for micro-irrigation technologies (Palanasami 2012, also verified with farmers focus group discussions at selected villages of Karnataka and in Maharashtra in early 2013).

***Benefits of drip irrigation system*:**

In our consultation with farmers in the selected villages of Sholapur district of Maharashtra (SAT region) and in Bijapur district of Karnataka, in early 2013, farmers revealed the following benefits reaped when the drip irrigation (micro-irrigation) technology was used.

- *Saving on labor cost:* Labor cost was reduced by 75% when drip irrigation on grape gardens (also on vegetables) was used when compared to flooded irrigation.
- *Saving on water applied*: The farmers reported a saving of 60-70 % of the applied water under drip when compared to flooded irrigation. Given the availability of water, the farmers group reported that they would have to reduce the grape acreage by 1/3rd, if they had not adopted the drip.

- *Convenient in farming and less drudgery*: Under the drip system, usually the owner farmers themselves apply fertilizers in the drip system and minimize fertilizer quantity (cost), which leads to less nutrient loss due to localized application, reduced leaching, and also reduced labor time in operation.
- Less need of weeding reduce diseases and pest incidence as well as weeding cost.
- Crops can be grown even in an uneven land, due to high pressure drip water which can reach the plant root in an uneven land as well.
- Under drip irrigation, and with plastic mulch, weed growth is substantially minimized, thus giving additional benefits with increased crop yield and reduced weeding cost.
- Under drip irrigation, water distribution is uniform across the plot thus leading to uniform production across the plants within a plot, and good quality produce.
- Under the drip, foliage remains and only root gets wet, thus reducing the risk of disease and pest attack on foliage, and ultimately improving crop yield as well as quality of the produce.

All these factors led to an increase in farmers return and profitability under the drip systems when compared to flooded irrigation. However, in detailed group discussions, the same group of farmers also pointed out some of the disadvantages of drip irrigation systems.

***Some of the disadvantages of drip irrigation systems*:**

- *High installation cost of the drip and the overhead system*. The total installation cost in many places goes as high as Rs. 50,000 per acreage. In Karnataka state, the government subsidy is about 75% of the initial installation cost.The National Mission of Horticultural Crops is providing 50% for installing the systems to grow horticultural crop, which is topped by another 25% of subsidy from the state government; which is however limited to Rs. one lakh per farm. The level of government subsidy and the level of adoption of micro-irrigation vary across different states of India. In Andhra Pradesh, the government subsidy on installing micro-irrigation system is as high as 90% of the installation cost (Palanisami et al., 2012). Likewise, the prerequisite for availing the subsidy varies greatly across the Indian states. Everywhere, the government subsidy is associated with high transaction cost, and in many cases, the subsidy amount reaches the

farmers only after 6 to 12 months after submitting the applications. At a large number of places, however, the government subsidy on micro irrigation has often been captured by the large and well-to-do farmers rather than small and marginal farmers.

- *Higher maintenance cost and clogging of the system:* The operation of drip requires slightly advanced technical know–how If the water is not properly filtered and the equipment is not properly maintained, the system gets easily clogged leading to an increased cost of maintenance, de-clogging of the system, etc.
- *Lack of institutional finance for purchasing the micro-irrigation sets. Local banks or credit agencies rarely provide credit for purchasing the micro-irrigation systems.*
- The drip pipes may last for more than 5-6 years, but keeping them in a safe place is a problem for most of the farmers; they are often damaged by rats.
- Drip irrigation is more suitable for certain wider-spacing crops than narrow spacing crops (onion etc).
- The operation of pressure system of drip is more profitable if electricity is regular and assured so that the pump operation cost is reduced.
- Inadequate technical understanding on low-cost micro-irrigation uses among agricultural extension personals and other governmental agencies involved in rural development.

Conclusions

Micro-irrigation system was primarily promoted to save scarce water resources (applied water) more so in the areas of dry land farming. The same given level of water, allows farmers to grow crops on more acreage than in the case of flooded irrigation. However, in the recent past, it's potential to save labor use in irrigation; reduced drudgery and reduced cost of cultivation to farmers have become important factors and act as incentives for farmers to adopt this technology. Since, the rural labor market is increasingly tightening in all parts of India, farmers every where in India are pressed to search for alternate options to save the number of labor use days and lower the cost of operation. Therefore, farmers are getting attracted towards micro-irrigation (drip and sprinkler), more so in the intensive production areas with tight rural labor market.

However, the pace of development of the micro-irrigation system in India is not as high as in other countries like Israel, Egypt, Thailand and many other countries of East Asia. The reasons being policy constraints and a complex set of subsidy rent attached with the micro-irrigation systems, which deter further innovation on cost saving in technology use. The cost per unit of irrigation under micro irrigation systems (set) is relatively high in India than many other countries.

The subsidy on micro-irrigation systems are more or less obtained by better-off and well-to- do farmers, whereas small-holdings and poor farmers – who need such government support (more than others) are left out in utilizing the micro-irrigation technology. The huge subsidy on the scheme has adversely affected further innovation and refinement of the technology, and its cost structure, since, the cost of micro-irrigation technology per unit of acreage has not reduced over the years. There is a need to have a more pragmatic public policy and targeted subsidy on the micro-irrigation to the intended beneficiary (small and marginal farmers). The government subsidy should not hinder market innovation in refinement of the technology and search for a lower-scale (size) of operation unit, and lower cost of the technology, all of which will ultimately benefit the wider farming communities. Our discussion and consultation with groups of farmers at several villages in Maharashtra and Karnataka suggest that small and marginal farmers, who are (and who should be) the actual target of the government subsidy and public support systems, on promoting adoption of modern and innovative technology for the wider public benefit, are still out of reach of the application of micro-irrigation systems.

References

Bhattarai M. 2008. Socio economic Impacts of Low cost Tank with Drip Irrigation for Vegetable Production: A Community Scale Case Study in Nepal. A poster presented at World Water Congress, Montpellier, France, 1-4 Sept. 2008.

Mariyono J and Bhattarai M. 2009. Chili Production Practices in Central Java, Indonesia: A Baseline Report. AVRDC- The World Vegetable Center, Shanhua, Taiwan.

Midmore DJ and Jansen HGP. 2003. Supplying Vegetables to Asian Cities: Is There a Case for Peri-urban Poduction? Food Policy, 28:13-37.

Namara RE, Nagar RK and Upadhyay B. 2007. Economics, Adoption Determinants, and Impacts of Micro Irrigation Technologies: Empirical Results from India. Irrigation Science 25:283-297.

Narayanamoorthy A 2004. Drip Irrigation in India: Can it Solve Water Scarcity? Water Policy 6: 1-14.

Polak P and Yoder R. 2006. Creating Wealth from Ground water for Dollar-a-day Farmers: Where the Silent Revolution and the Four Revolutions to End Rural Poverty Meet. Hydrogeology Journal 14: 424–432.

Palanasami K. 2012. Micro Irrigation in India: An Overview (chapter 1). In Palanisami, K, Raman S, Mohan K (eds). Micro Irrigation: Economics and Outreach. Macmillan Publisher India Ltd. p.1-10.

Sustaining Diversification of Agriculture Towards High Value Crops Through Market Reforms and Policy in India

P Parthasarathy Rao and LM Pandey

Diversification of the Food Consumption Basket

In the last 2-3 decades there have been dramatic changes in the structure of domestic food consumption demand and consequently its markets. Specifically, between 1983-84 and 2009-10 expenditure shares on food items at all-India level shows a shift in the consumer food basket towards high value food commodities like fruits, vegetables, milk, meat, beverages in both rural and urban areas with a significant decline in expenditure shares on cereals. Ravi and Roy (2006) predicted demand for high-value food products to grow at an annual rate of around 5% by 2020, as against 2.5% for food grains. Rising incomes, growing urbanization and change in tastes and preferences are driving these changes and will continue into the foreseeable future since urban population is growing faster than rural population and incomes are expected to rise due to faster economic growth. Income elasticity of demand for high value food commodities as also for pulses and oilseeds is higher than for cereals ranging from 0.80 to 1.04 (Ravi and Roy 2006; Kumar et al 2007). Another change that is particularly pertinent to rainfed regions is the decline in food use of coarse cereals while at the same time alternative uses are emerging in a big way, for example, poultry feed, alcohol manufacturing etc. The growing demand for livestock products is driving the derived demand for the grain and fodder of coarse cereals. This has implications on the marketing of these crops that were otherwise solely grown for home consumption.

Diversification in Agricultural Production

In response to the growing demand for high value food commodities, growth in high-value segment of agriculture accelerated. Between 1980 and 2009 the value of rice and wheat production grew at 2% compared to more than 4 % for fruits and vegetables, milk, meat and eggs. Cotton, condiments and spices, and floriculture (from low base) are other crop groups that are growing fast. Consequently, the share of crops/

crop groups in agricultural production portfolio has also undergone a change. Between 1980 and 2010 the share of fine cereals in total value of agricultural production has declined from 25% to 20%, while the share of fruits-vegetables, milk and meat has increased. Consequently, the value of fine cereals was Rs.2,182 billion, while the value of fruit, vegetables, and milk were not far behind, contributing Rs. 1,838 billion and Rs.1,892 billion respectively in 2009-10. The faster growth in high value commodities provided a cushion to the agricultural growth, which otherwise would have decelerated at a faster rate.

The changes are also reflected in the rising share of livestock sector in the total value of crop and livestock sector. The share of livestock sector increased from 19% in 1980 to 26% in 2010. As indicated, to meet the growing demand for livestock products the derived demand for coarse cereals, soymeal etc. are increasing. For example, the poultry sector is growing at 8-10% and since coarse cereals constitute upto 50% of their rations, the demand for coarse cereals like maize, sorghum etc. is increasing both from the poultry feed sector and cattle feed industry (Klieh et al 2002, Basavaraj and Parthasarathy Rao 2011, Parthasarathy Rao and Basavaraj 2011). Besides molasses the alcohol industry is using grains to produce alcohol for potable alcohol and for pharmaceutical industry. Based on their market prices, broken rice, pearl millet and sorghum are some of the grains used in the alcohol industry.

Drivers of Agricultural Diversification

There have been a number of studies on factors driving diversification at the farm level. Joshi et al 2007, found that determinants of diversification towards horticulture crops included both demand and supply side factors. From the demand side, urbanization and income were the main drivers. From the supply side, relative profitability, roads and market network were positively effecting diversification. Rainfall and irrigation were negatively associated with horticulture crops implying that horticulture crops were expanding in areas with low-irrigation under low to medium rainfall regimes. One surprise result was the positive relationship between horticulture commodities and proportion of small holders. However, they qualify this by stating that in the absence of appropriate markets small holders' opportunities may be affected.

Similar results were found by Parthasarathy Rao et al 2006 and 2007. Looking at a more regionally disaggregated picture (using district level data), these studies found that diversification of agriculture is growing

fast in peri-urban areas i.e., urban districts (districts with large urban cities), and in districts neighboring urban districts (urban surrounded districts); medium to high rainfall districts; districts with good road network and infrastructure facilities (markets, veterinary services). Diversification was faster in urban surrounded districts that are connected with national/state highways to the urban centers. On the other hand irrigation area under HYVs and high input agriculture in better endowed regions has a negative influence on HVCs. As an example, we see contrasting trends in diversification of agriculture in Punjab (with high irrigation levels) and Andhra Pradesh (with moderate irrigation levels). Between 1992-93 and 2008-09 the share of livestock, fruits and vegetables in total value of agriculture production has grown faster in Andhra Pradesh at the expense of other crops when compared to Punjab.

Challenges of High Value Agriculture Particularly For Small Farmers

Despite the robust response of farmers to rising demand for high value commodities, there are apprehensions on sustaining the higher growth rates unless institutional reforms and policy changes are brought about to sustain their growth. The nagging inflation the country is facing is partly attributed to supply side constraints in raising the production of high value commodities. The present marketing systems and institutions are geared towards marketing of crops like cereals, pulses, oilseeds etc. High value food commodities are perishable and hence need different marketing strategies and institutional arrangements that link farmers to end users. The increased demand for high value commodities (HVCs) in India is creating opportunities as well as challenges for farmers. There are strong monetary incentives for the farmers to diversify cultivation to high value commodities due to their strong potential for higher returns to land, labor and capital. The potential stumbling block is that smallholders dominate Indian agriculture. Small size implies that the marketable surpluses are small, leading to high transactions costs. Also, it is feared that small holders will not be able to meet the quality standards required by the consumers and processors owing to lack of access to the right technology and infrastructure. The processing sector is consolidating and getting bigger and bigger while farm sizes are shrinking. There are thus apprehensions that processors (fruit, vegetable, milk, meat, feed, alcohol, etc.) and super market chains would overlook the small farmers since they need bulk quantities of specified qualities year round.

Measures to Promote Diversification to High Value Commodities

There are a number of constraints to agricultural diversification. These include constraints related to credit, infrastructure (particularly cold storages refrigerated transportation), quality standards and SPS issues. High value commodities are capital intensive and availability of credit is a must for small scale producers. Earlier studies have however found that bulk of the primary credit from the formal sector goes for traditional crops like food grains, sugarcane, cotton and oilseeds. Even within the crop sector vegetables get a very small share of primary credit (Parthasarathy Rao et al 2008). SPS issues are becoming increasingly important particularly for exports. Under trade liberalization and globalization, stringent quality standards are imposed and crop production practices and post-harvest handling standards are also spelled out involving additional investments at the farm level.

Measures to promote and sustain diversification include market reforms by bringing institutional innovations in linking farmers to end users (contract farming, bulk marketing through growers association); ICT enabled supply chains; reforms related to food processing industry (food processing policy); investment in infrastructure; promotion of commodity clubs, farmers associations etc. The government of India has taken some steps in this direction, the most important being market reforms.

Model Agricultural Produce Marketing Act

An efficient marketing system should reduce post-harvest losses, enhance farmers' realization, reduce consumer prices, promote grading and food safety practices, induce demand-driven production, enable higher value addition and facilitate exports. Structural and institutional reforms are necessary to make the present agricultural marketing system competitive and efficient. The Model Agricultural Produce Marketing Act is an attempt to overcome some of the major bottlenecks in the present system and to promote competitive marketing from farm to the consumer's plate. The Act highlights the need for an alternative marketing system to promote direct marketing, smooth raw material supplies to agro-processing industries, competitive trading, organized retailing, information exchange and adoption of innovative marketing systems and technologies (Ministry of Agriculture, 2003):

Specifically some of the key recommendations include: Setting up of new markets by private sector or other parties; separate markets for

special commodities; direct marketing by farmers to agro-processors; provision for contract farming; formation of Farmers' Associations for bulk marketing; pledge financing and instituting a system of negotiable warehouse receipts; ensuring complete transparency in the pricing system and transactions; providing market-led extension services to farmers; dissemination of market intelligence information (arrivals and prices data); promotion of public–private partnerships in the management of agricultural markets; wider role of State Marketing Boards in training & extension in market related areas; constitution of Standards Bureau at State level; Imposition of single-point levy of market fee on the sale of notified agricultural commodities in any market area. Several state governments have incorporated provisions of the act into their regulated market act. However, ground level implementation is far from satisfactory.

For smooth implementation of the model marketing act, the government should play a role in increasing investments in infrastructure (roads, cold storage, bulk coolers); foster improved linkages between rural-urban markets; set up information kiosks on prices, arrivals, quality standards; promote horizontal and vertical integration through innovative institutional linkages; harness private sector innovations in food marketing; establish effective mechanisms for dispute settlement; simplify procedures for setting up food processing industries; incentives to agro-processing industry to strengthen backward and forward linkages; enhance access to formal credit and insurance and establishment of Agricultural Exports Zones (AEZs).

References

Basavaraj G, Parthasarathy Rao P, Bhagavatula S and Ahmed W. 2010. Availability and Utilization of Pearl Millet in India. Journal of SAT Agricultural Research 8. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Joshi PK, Gulati Ashok and Birthal PS. 2007. Agricultural Diversification in India: Status, Nature and Pattern. Pages 219-242 in Agricultural Diversification and Small holders in South Asia. Joshi PK, Ashok Gulati, and Ralph Cummings Jr (Eds). Academic Foundation, New Delhi.

Kleih U, Bala Ravi S, Dayakar Rao B and Yoganand. 2002. Industrial Utilization of Sorghum in India. Working Paper Series no. 4. Patancheru

502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 44 pp.

Kumar P, Mruthunjaya and Birthal PS. 2007. Changing Consumption Pattern in South Asia Pages 151-169 in Agricultural Diversification and Small holders in South Asia. Joshi PK, Ashok Gulati and Cummings Ralph Jr (Eds). Academic Foundation, New Delhi.

Ministry of Agriculture. 2003. Directorate of Marketing & Inspection. Government of India. Salient Features of the Model Act on Agricultural Marketing.

Parthasarathy Rao P, Joshi PK, Kumar S and Ganguly K. 2008. Agricultural Diversification in Andhra Pradesh, India: Patterns, Determinants and Implications. Research Report No. 2, GT-IMPI Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Parthasarathy Rao P, Birthal PS Joshi PK and Kar D. 2007. Diversification of Agriculture towards High Value Commodities and Role of Urbanization in India. Pages 243-270 in Agricultural Diversification and Small holders in South Asia. Joshi PK, Ashok Gulati and Ralph Cummings Jr (eds). Academic Foundation, New Delhi.

Parthasarathy Rao P, Birthal PS and Joshi PK. 2006. Diversification towards High-Value Agriculture: Role of Urbanization and Infrastructure. Economic and Political Weekly, June 30, pp. 2747-2753.

Parthasarathy Rao P, Basavaraj G, Ahmad W and Bhagavatula S. 2010. An Analysis of Availability and Utilization of Sorghum Grain in India. Journal of SAT Agricultural Research 8. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics

Ravi C and Roy D. 2006. Consumption Patterns and Food Demand Projection: A Regional Analysis. Paper presented at the Workshop 'From Plate to Plough- Agricultural Diversification and its Implications for Smallholders' organized by the International Food Policy Research Institute, New Delhi office, and Institute of Economic Growth, New Delhi, India on September 20-21, 2006.

Addressing Gender Equality in Rainfed Agriculture

Chanda Gurung Goodrich

The rainfed regions of the world are the poorest and most food deficient areas due to the low productivity of land and limited water resources. In the recent decade this has been exasperated by erratic climatic conditions and increasing population. The farmers are mostly small holders engaged in subsistence farming. In such an economy the roles of both men and women are very important as both are involved in cropping and livestock enterprises equally. Women are equally, if not more responsible for certain tasks such as sowing, weeding, harvesting and processing. In fact, women's workloads are greater in rainfed agriculture than in irrigated areas due to the poor economic standards of these areas. Despite women's dominant and critical role in the agricultural sector (as cultivators, labourers, processors, traders, and entrepreneurs), and as generators of major source of income for household and national economies alike, the value and importance of women's activities is not always proportionate with their decision-making rights. Access to and control over the resources, including markets, new technology, and income is poor. Women usually face extreme challenges and constraints in accessing resources, farm inputs, services, knowledge, opportunities, and their productivity remains low relative to their potential. This affects agricultural production, economic growth and well-being of their families, communities and so the countries.

Thus, gender is one of the most common determinants of inequity which intersects other socio-economic factors that create differences between individuals. The deep-seated social inequalities go against women denying them an effective voice in decision-making and management both at the household and community level. In agriculture too gender is an important determinant of agricultural outcomes, in terms of resource management and productivity. The gender gap encompasses differences between men and women in a range of areas – ownership, user rights over resources including land, water, livestock; capacity to capture beneficial environmental services; financial capital; labour use and the returns to labor; in political and social capital (empowerment) and in

their access to technology, training, information and agricultural advisory services in general. Furthermore, women face a distinctive disadvantage, since they are the ones who sacrifice their opportunity for education and skill development to manage land and agriculture. In recent years, gender inequalities are even more significant in most rainfed regions of the world as the numbers of female headed households are increasing. The harsh conditions combined with increased population and low returns from agriculture has resulted in large numbers of men leaving agriculture in search of employment in off-farm activities in urban areas, leaving women to assume many tasks that were earlier done by men. These female headed households are frequently faced with numerous disadvantages such as insecure property rights, shortages of adult labor, limited access to the means of production compared to male headed households. Inequitable opportunities for asset accumulation and income generation thus place these women and their households among the most vulnerable segments of the rural poor. Due to such gender differential access to and control over resources, the yield gap between men and women averages around 20–30%, and a large body of studies have found that if women farmers had access to and control over the same level of resources as men on the land they farm, they would achieve the same yield levels if not more.

Much of the development community today recognizes that changing research and development (R & D) from male dominated to gender-equitable farming is not merely an issue of political correctness or ideology; it is a matter of development effectiveness that can benefit everyone. It is increasingly realized that the chances of growth and improvement in poverty reduction are closely linked with gender equality and decline in deprivation of women and girls. There is a growing evidence that gender plays an important and strategic role in promoting economic growth, poverty reduction, and development effectiveness. When women and men are relatively equal, economies tend to grow faster, the poor move quickly out of poverty, and the well-being of men, women and children is enhanced. Recent discourse on building economic power for rural communities has drawn attention to two dimensions: ownership and control of certain assets such as land, housing, livestock, common property resources, businesses, health and finances as leveraging factors in pursuing gender equality. Similarly, a recent study done by the Commission on Growth and Development acknowledges and emphasizes that gender equity is supportive of

efficiency and growth. As such, programs and projects that ignore gender specific barriers to resources, opportunities, and benefits have a risk of excluding a large proportion of farmers (who are women) and the farming community.

Hence, it is important to create and promote equity structures that deal with gender equality, promote local capacities and do not impede development and expanding opportunity to achieve inclusive growth. The promotion of gender equality implies explicit attention to women's needs, interests and perspectives. It means that policies and operational strategies affecting the agricultural sector should explicitly consider the gender dimensions in particular areas where gender related factors are expected to play a significant role such as management of land, trade and markets. A number of research studies have confirmed that closing the gender gap in agriculture can improve not only agricultural productivity, but also bring about important additional benefits of raising the incomes of women farmers, increasing the availability of food and reduction of food prices, raising women's employment and real wages. According to FAO's latest estimates, 925 million people are currently undernourished. Closing the gender gap in agricultural yields could bring that number down by as much as 100–50 million people. Thus, promotion of gender equality and empowering women in (rainfed) agriculture is crucial to fight against hunger and poverty. Furthermore, gender equality in access to opportunities and returns to assets will lead to a rise in the level of human capital in society through improved nutrition, health and education outcomes, which in turn can have a long-lasting impact on economic growth.

Role of Social Networks in Promoting Agricultural Development

R Padmaja

One of the ways to reduce poverty in agrarian societies like India is to promote the adoption of new agricultural practices and technologies by both men and women, thereby raising the agricultural output and productivity on a sustainable and equitable basis. Agriculture in India has seen profound changes during the last five and a half decades. However, these technological changes and investments were concentrated in the more favourable regions like the Indo-gangetic plains. The trickle-down effect of these technological changes in the semi-arid tropics (SAT) was slow and in some cases it did not take place at all. The crops grown in the SAT were mostly subsistence crops like sorghum, pearlmillet, fingermillet, and pulses, and these did not receive the attention of either the researchers or the policy makers. Availability of water is a major constraint in these regions. Even though the SAT region is now experiencing technological changes through the introduction of downy mildew resistant pearlmillet, short duration chickpeas and pigeon peas, drought resistant groundnuts, wilt resistant cultivars, to name a few, the policy and investment bias still exists.

In a nutshell, it can be said that the technological change in the SAT is slow and less dynamic compared to the regions with better soils, water and irrigation facilities. With the emergence of the dual phenomenon of feminization of agriculture (and labour)due to male migration and feminization of poverty, it is imperative to recognize the realized as well as potential contribution of both men and women farmers in agriculture and understand their decision processes and constraints. The harsh environment of the SAT necessitates collective action as a coping mechanism to overcome the challenges of extreme weather events, poor resource endowments and policy bias to bring about significant economic changes. Understanding and acknowledging the role of social capital through social networks in the nexus of technology adoption, exchange and spread is therefore essential to facilitate large scale diffusion of technologies.

It is now widely recognized that the information revolution in India has given birth to new economies structured around flows of information and knowledge. Village communities are not homogeneous entities but a combination of complex networks of social relationships. Many factors such as ethnicity, caste, gender, socio-economic status, and power relations determine one's access to information and resources. Social networks have therefore grown stronger as forms of organization of human activity. Social relationships in agricultural communities have traditionally been characterized by strong, often life long ties through small, homogeneous local networks. As farming is reshaped by changes in the global agricultural system, new forms of relationships for both conventional and alternative farmers are emerging which may involve unfamiliar players, innovative business models and distant geographies. An important implication of this change is that relational skills for interacting effectively in networks have become critical to success of farm business. An inadequate understanding of local social networks, norms, and power relations may lead to the formulation of policy recommendations that are not favourable to the local needs. This may further the interests of better-off farmers and marginalize the poor. As reiterated earlier, for the harsh environment of the SAT which experiences a bias in terms of investments, technological innovations, policies and government support, social networks are one form of institutions which can help rural women and men help themselves through norms of trust, reciprocity and sharing of resources, technologies and knowledge.

My experience at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) was documenting and mapping the social network architectures of women and men in rural communities in the SAT. The case studies and the sociological analysis demonstrate that formal and informal social networks mediate technology adoption and play an even greater role in the diffusion of technology. The non-availability of (or difficulty in obtaining) formal insurance and inadequate financial, agricultural information delivery and extension systems in the study villages has prompted the development of kinship networks in one village and self-help groups in another. Networks based on kinship proved to be one of the channels through which agricultural technology spread not only with in the entire village, but also to the neighbouring districts, thereby promoting agricultural development. The analysis also leads to the conclusion that villages/rural communities which are endowed with a diverse stock of social networks and civic associations are in

a stronger position to deal with changes in the external environment, resolve conflicts, and take advantage of new opportunities. The SAT has a heterogeneous population – heterogeneity in terms of human capital, resource endowments, financial capital as well as social capital. It is documented that information flows less smoothly in a heterogeneous population. Hence the role of social networks either by caste, kinship or even class in the spread of information becomes more important in the SAT.The gender-based social analysis clearly illustrates how social networks influence and shape individual and collective behaviour in the process of agricultural development. The mapping of the social network architecture facilitates the identification of strategies by development practitioners through viable entry points for innovation and intervention, media for collective action, pathways of information flows and access to resources and services. Understanding adoptive and adaptive capacity ultimately provides a basis for identifying delivery channels for technical adaptation and adoption options. Social networks as a form of institutional arrangements, particularly in SAT agriculture play a critical role in promoting agricultural development.

From a broader development perspective, I argue that policy interventions and government support must target areas where the linkages are weak or missing or lacking keeping in view the differences by gender and caste, especially in the rural areas where agriculture continues to be the dominant source of livelihood for many.


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Mission
To reduce poverty, hunger,
nutrition and
ronmental degradation
e dryland tropics.

Dealing with Risks and Uncertainties in Rainfed Agriculture

Hans P Binswanger-Mkhize

In the middle of the 1970s, ICRISAT set up its Village Studies Program that collected data from 240 farmers and landless workers in six villages of the semi-arid tropics (SAT) of India for ten consecutive years, and thereby provided the foundation for a series of path-breaking studies of behavior of farmers in high-risk rainfed agriculture. These are described in Walker and Ryan (1990) and additional journal articles. The studies showed the exceptional risks of farm profits in the SAT that stem from highly variable yields and prices. They documented the ex-ante and ex-post adjustment mechanisms used by farmers to cope with such high risk. These include crop diversification, intercropping, drawing down stocks and savings, gifts and loans from relatives or within close social network, seeking of employment in distant labor markets and in government employment programs, as well as savings in the form of draft animals that can be sold during prolonged drought (Rosenzweig and Wolpin, 1985), and marriage alliances that span wider geographic areas with increasing riskiness of agriculture (Rosenzweig and Stark, 1989).[1] Village studies were revived at ICRISAT in 2001 under the leadership of Cynthia Bantilan.

The ICRISAT studies that included experimental measurement of risk aversion (Binswanger, 1980) and discount rates of farmers (Pender, 1996) are still used as models all around the world. These show that when payoffs are fairly high, farmers typically are moderately risk averse, with very few farmers being extremely risk averse and none being risk preferring. The studies also showed that when farmers and landless workers are offered one bag of rice today versus two bags of rice in two months, nearly one half choose the rice today, even though it is an extremely unattractive option in terms of returns. This suggests that many of them have extremely high revealed discount rates and suffer from extreme liquidity and credit constraints. These two experiments suggest that liquidity and credit constraints are more likely to restrict input use and investment in dry-land

[1] Many of these mechanisms have recently been reviewed at the global level (Bhattamishra, R. and Barrett, C.B., 2010)

agriculture than risk aversion (Binswanger and Sillers, 1983, Holden and Binswanger, 1998).

The data were used to test whether the informal risk diffusion mechanisms used by farmers were sufficient to self insure them so that the extreme variability of farm profits would not be reflected in the variability of consumption or food consumption (Rosenzweig and Binswanger, 1993). It was found that for household–specific risks such as illness or accidents, food consumption does not subsequently decline, but other expenditures do, suggesting that informal mechanisms are quite effective for these risks. For covariant or village and regional shocks, however, even food consumption declines. When all households in a village or small region experience a shock, they cannot help each other out, and the informal risk sharing mechanisms break down. This insight has led to the recognition that social protection should primarily insure covariant risks, while informal arrangements are able to insure household- or individual-specific risks.

Input use and investment behavior is also constrained when risks are not perfectly insured (ibid). The study showed that the wealthier farmers are sufficiently well insured via their informal mechanisms so that they can invest in the most profitable inputs and capital items, and so have profit-maximizing investment portfolios. On the other hand, poor farmers have to invest part of their funds into inputs and capital items that are risk reducing but have to endure lower returns. The investigation showed that they sacrifice (on an average) about one third of the return to capital by doing so, while the large farmers can reap the full benefits.

The ICRISAT village studies led to the recognition that it is covariant risks, combined with transaction costs and moral hazard[2], that make the provision of credit and crop insurance very difficult in rural economy (Binswanger and Rosenzweig, 1986). The three factors explain why it has been so extraordinarily difficult to develop viable agricultural credit systems, why micro-finance is so difficult to apply for agriculture, and why crop insurance has not been able to assist in managing the riskiness of agricultural credit – if it suffers from the same fundamental covariance

[2] Moral hazard arises when a farmer reduces his effort to prevent crop failure because he anticipates an insurance payout, or when he exaggerates his loss to get a higher payout.

and moral hazard problems as credit, it cannot be used to insure credit (Binswanger, 1987).[3]

What then are the best ways to help farmers manage their high profit risks, and especially their covariant risks stemming from the weather and from sharp fluctuations in market prices? Since the Indian Famine Codes that were elaborated at the end of the 19th century, employment generation has been the preferred system for emergency relief in India and many other countries. It can help both small farmers and landless workers, who either have less work on their own farm or whose agricultural employment opportunities have collapsed. An additional advantage of such a program is that the beneficiaries who need it will self-select into the program, while to those who do not need it will not apply.

In the ICRISAT village studies it was found that there had not been any distress sales of land since the 1950s primarily because of the presence of employment generation (Walker and Ryan, 1990). In Bangladesh such programs were much less prevalent and distress sales of land were observed even in the 1960s to 1980s. Distress sales of productive assets, especially of land, have put households on the path of destitution, and are to be avoided at all costs. The Maharashtra Employment Guarantee Scheme was already in operation during the study period in the ICRISAT villages, and has inspired the development and rollout of the MNREGA employment program all over India. This program has the potential to make a big contribution to risk management of farmers and landless workers all over India.

A second approach is the breeding of improved crop varieties and livestock races that are resistant to water stress, flooding, and pests and diseases. Such programs are now an important agenda for the CGIAR and for national agricultural research institutions. A third approach that

[3] Covariant risks, spatial dispersion, seasonality, moral hazard, and the attributes of factors of production also determine the production relations in agriculture, including for example the nature of labor contracts and labor markets, the preference for land as collateral or collateral substitute in credit markets, the preference for accumulating draft animals partly for the purpose of risk diffusion, and many more (Binswanger and Rosenzweig, 1986). These insights have entered the mainstream of agricultural economics and been applied to many different environments.

[4] The development of road networks and other public investments, and of communication systems like cell phones, also helps in reducing risks, especially by facilitating ex-post adjustments. For example a cell phone reduced the cost of searching for employment in more distant areas when drought reduces employment at home.

has shown a lot of promise, for example recently in Gujarat, is drought proofing of agriculture via water harvesting under-ground and in ponds and small reservoirs.[4]

For the reasons already discussed, the experience with crop insurance has not only been very long but also very disappointing. All yield crop insurance that assessed each farmer's yields has proven impossible to implement without heavy subsidies all across the world (Hazell, et al, 1987). Instead, insurance systems are now being implemented or tried out that pay out on an insurance contract either when average yield in an area drops (area-based insurance), or when rainfall drops below the agreed threshold in particular time periods (rainfall insurance) (Binswanger, 2012). This eliminates the moral hazard, and also the cost of assessing output in each field. However, it leads to a so called "basis risk," which arises when a farmer has a loss at a time when other farmers in his areas do not, or when the rainfall measured at the weather station is good, while the one at his field is poor. Basis risk has recently shown to be a high barrier to the adoption of area-based insurance or rainfall insurance, because when this happens the farmer will be worse off than when he had not bought the insurance at all. He had already paid the insurance premium and had got no insurance payout and he also suffers a loss.

The other main constraint to crop insurance of any kind is that, better-off famers are already sufficiently well insured to have profit maximizing portfolios (Rosenzweig and Binswanger, 1993). Unless the insurance premium is less than the cost of the informal insurance mechanisms that provides the same insurance benefits, they will not have any demand for insurance. For the poor farmers, however, an appropriate insurance could help them invest in more profit maximizing portfolios of assets and inputs, and achieve higher incomes. As we have seen, they are extremely liquidity constrained, and will not be able to purchase the insurance when it is offered (ibid). Many programs are therefore attempting to overcome the liquidity constraint by insuring only credit, but such an approach is more beneficial to the bank than to the farmer. Another way tried in Ethiopia is to let farmers earn the premium in an employment generation program. However, it is not obvious why crop insurance is needed to diffuse risk if there is a good employment generation program.

In addition, any insurance that insures the yield of a particular crop is far away from insuring total farm profit - the key variable that needs to be insured to alter investment behavior of farmers (Binswanger, 2012).

There are some companies that are experimenting with insuring the value of the crop instead, which gets us closer to farm profit (Dercon. 2009, Hess and Hazell. 2009, Hazell and Hess. 2010). This requires the development of insurance products by the company that reinsures rainfall risks in international markets, as well as insures the price risks in forward markets.

If there is no dominant crop, then only a small portion of the profit risk will be insured by focusing on a single crop. Mongolia has a livestock insurance program against severe winters (dzud) that insures households' livestock herds, and Kenya has one that insures them against drought. The herders derive almost their entire income from their herds, as they rarely grow crops and usually cannot engage in non-farm work. As a consequence this insurance ensures the capital stock behind all or almost all of the farm profits, and is therefore much closer to an ideal insurance product than crop-specific insurances (Carter 2009).

It is not surprising that the uptake of the new weather-based insurances has been quite limited across the World. A fairly small proportion of farmers tend to buy it, and if bought, they tend to buy the smallest amount possible (Giné, 2009). As a consequence it is hard to see how these programs can have a large impact on farmer investment and input use behavior. And with such a small proportion of farmers insuring, and of their risk covered, the government will still have to come up with employment generation program or other relief to counter natural disasters such as drought or flood.

The conclusion therefore espouses that a functional employment generation program is likely to be a more powerful approach to risk management in dry land agriculture (Del Ninno et al. 2009; Binswanger 2012). It would leave out those households that cannot work and countries such as Ethiopia, India, and China therefore have special programs for the social protection of these populations. In addition, desirous of making improved crop and livestock varieties more stress-resistant, and drought proofing the dry land areas will continue to be of very high priority.

References

Alderman H and Haque T. 2007. Insurance against Covariate Shocks: The Role of Index-based Insurance in Social Protection in Low Income Countries of Africa, Human Development Working Paper No. 95, Washington, DC: World Bank.

Bhattamishra R and Barrett CB. 2010. Community-based Risk Management Aarrangements: A review. World Development, 38(7), pp. 923–932.

Binswanger HP. 1980. Attitudes toward Risk, Experimental Measurement in Rural India. American Journal of Agricultural Economics, 62, pp. 395–407.

Hans P Binswanger, "Risk Aversion. 1987. Collateral Requirements, and the Markets for Credit and Insurance in Rural Areas." In Hazell, Peter, Carlos Pomareda and Alberto Valdez, Crop Insurance for Agricultural Development, 1987, Baltimore and London, Johns Hopkins University Press. Part I, Chapter 4, pp.67-86.

Hans P Binswanger-Mkhize. 2012. Is there too much hype about index-based agricultural insurance? Journal of Development Studies, 48:2, 187-200

Binswanger HP and Rosenzweig MR. 1986. Behavioural and material determinants of production relations in agriculture. Journal of Development Studies, 22(3), pp. 503–539.

Binswanger HP and Sillers DA. 1983. Risk aversion and credit constraints in farmers' decision-making: a reinterpretation. Journal of Development Studies, 20(1), pp. 5–21.

Carter M. 2009. Intelligent Design of Index-insurance for Smallholder Farmers and Pastoralists, Focus 17: Innovations in insuring the poor, Brief 6, Washington, DC: International Food Policy Institute.

Del Ninno C, Subbarao K and Milazzo A. 2009. How to Make Public Works Work: A Review of the Experiences, Social Protection Discussion Paper 0905, Washington, DC: World Bank.

Dercon S. 2009. Risk, Poverty, and Insurance, Focus 17: Innovations in insuring the poor, Brief 3, Washington, DC: International Food Policy Research Institute.

Giné X. 2009. Experience with Weather Index-based Insurance in India and Malawi, Focus 17: Innovations in insuring the poor, Brief 7, Washington, DC: International Food Policy Research Institute.

Hazell PBR and Hess U. 2010. Drought insurance for agricultural development and food security in dryland areas. Food Security, 2, pp. 395–405.

Hazell PC, Pomareda and Valdez A. 1987. Crop Insurance for Agricultural Development, Baltimore and London, Johns Hopkins University Press.

Hess U and Hazell PBR. 2009. Sustainability and Scalability of Index-Based Insurance for Agriculture and Rural Livelihoods, Focus 17: Innovations in insuring the poor, Brief 5, Washington, DC: International Food Policy Research Institute.

Holden ST and Binswanger HP. 1998. Small-Farmer Decision Making, Market Imperfections, and Natural Resource Management in Developing Countries, Chapter 5 in Lutz, Ernst, ed., with the Assistance of Hans P Binswanger, Peter Hazell and Alexander McCalla, Agriculture and the Environment: Perspectives on Sustainable Rural Development, Washington DC, A World Bank Symposium, pp 50-70.

Pender JL. 1996. Discount rates and credit markets: theory and evidence from rural India. Journal of Development Economics, 50, pp. 257–296.

Rosenzweig MR and Wolpin K. 1985. Specific Experience, Household Structure and Intergenerational Transfers: Farm Family Arrangements in Developing Countries, Quarterly Journal of Economics 100, suppl. (1985): 961-87.

Rosenzweig MR and Binswanger HP. (1993) Wealth, Weather Risk and the Profitability of Agricultural Investment. Economic Journal, 103, pp. 56–78.

Rosenzweig MR and Stark O. 1989. "Consumption Smoothing, Migration, and Marriage: Evidence from Rural India." Journal of Political Economy 97(4):905–26.

Rosenzweig MR and Wolpin KI. 1989. "Credit Market Constraints, Consumption Smoothing, and the Accumulation of Durable Production Assets in Low–Income Countries: Investment in Bullocks in India." Department of Agricultural Economics, University of Minnesota, St. Paul. Processed.

Walker TS and Ryan JG. 1990. Village and Household Economics in the Semi-Arid Tropics of India. Baltimore and London, The Johns Hopkins University Press.

FDI in Multi-Brand Retail: Will it Benefit Small Holder Farmers?

SS Acharya

The Government of India allowed foreign direct investment (FDI) in multi-brand retail (MBR) in September 2012. This was through reiteration of a decision taken in November 2011, which was put on hold due to strong opposition by some sections of the society, including some political parties. Allowing FDI in MBR basically aimed at accelerating the expansion of modern organized retailers (ORs) of various consumer goods that include farm products, both fresh and processed. For understanding the impact of FDI in MBR on the small holder farmers, there is a need to proceed stage-wise and first answer a series of related questions like (a) whether the entry of ORs will help in improving marketing efficiency of agricultural products; (b) whether the entry of ORs will help in improving farmers' incomes by way of higher prices for their produce; (c) whether the benefits of the entry of ORs will also reach the small holder farmers in an adequate measure; and (d) if the answers to earlier questions are positive, whether the entry of foreign retail investors (through FDI in MBR) will help in accelerating the positive outcomes, particularly for small holder farmers. It may be mentioned that positive answer to question 'a' is a necessary, but not a sufficient condition, for a positive answer to question 'b'. Further, positive answer to question 'b' is necessary, but not asufficient condition, for a positive answer to question 'c'. And, positive answer to question 'c' is necessary, but not a sufficient condition, for a positive answer to question 'd'. It is in this context that a sequential analysis is necessary to answer the critical thematic question of this paper.

Efficient agricultural marketing system is an essential pre-requisite for (a) accelerating agricultural growth, (b) improving farm incomes, (c) increasing physical and economic access of masses to food, and (d) making agricultural sector competitive in the world market. Recognizing this, the government of India has taken several steps during the last ten years that may be termed as a second phase of agricultural marketing reforms in India. The second phase of marketing reforms has been built

on the outcome and lessons of the first phase reforms that started in the 1960s as a part of food security and agricultural development strategy. The objectives of reforms at that time had been to assure a reasonable price to the farmers (as an incentive to increase production), maintain affordable prices of food for the consumers, and achieve a reduction in the marketing costs/margins to increase the marketing efficiency. The first phase of reforms included regulation of wholesale agricultural markets. These aimed at the creation of basic physical infrastructure in primary market yards, providing farmer-dominated market committees for management, and standardization of market charges payable by the farmers for various marketing services. As agriculture was (and continues to be) a state subject, a Model Agricultural Produce Markets Regulation (APMR) Act was circulated by the Centre to the states. It took around 18 years for the major states to adopt the Act. More than seven thousand primary agricultural produce markets were brought under the ambit of State APMR Acts. A large number of research studies in 1980s brought out that while major objectives of reforms were achieved, there had been a considerable gap between the intention of the regulation and practice on the ground. It was also found that several new problems had emerged in the regulated markets (notified market yards or sub-yards).

In the wake of the emerging situation, the entire agricultural marketing scenario, prevailing at that time, was comprehensively reviewed during the 1990s, which provided the basis for second phase of reforms. Amendments in the state APMR Acts were suggested by the Union Ministry of Agriculture to the state governments to inter alia allow direct purchases of farm products by bulk buyers from farmers, encouragement of contract farming or marketing, and linking farmers to the consumers or retailers. The Government launched several incentive schemes to attract private investment in agricultural marketing. Further, the organized retailing of farm products by domestic companies and FDI in wholesale (bulk handling and storage) trade of farm products was permitted. However, adequate private investment in agricultural marketing chain did not occur due to several factors. The huge wastage of farm products and avoidable losses (estimated to be Rs. 960 billion per annum) that occur in the marketing chain have continued unabated.

The need for encouraging modern organized retailers in agricultural commodities was felt due to the increase in demand for value-added services by the rising consumer incomes and lack of investment by the existing traders and unorganized retailers in agricultural marketing. In this

context, the entry of organized retail is aimed at improving the efficiency of the Indian agricultural marketing system. The practices adopted by ORs from procurement to retail helped in reducing the avoidable marketing costs, including the wastage. It was, therefore obvious that increased emphasis was needed to focus the attention on the entire marketing chain up to the retail level. Retailing is the last segment of the chain, which links farm gate to the consumers. Retailers, being closest to the consumers, face several challenges owing to different consumer choices and buying habits. For fruits and vegetables, Indian consumers have strong preference for fresh products accounting for 75% of total demand. Traditional unorganized retail formats in India include grocers or kirana stores, exclusive fruits and vegetable retailers, cycle or the lawalas and farmers themselves. According to one estimate, there are 11.2 million retailers of farm products who conduct a total business of around Rs.13 trillion. Most of these are family enterprises,which have less than 500 square feet area each and are under-capitalized. The per capita retail space in India is very low, being the lowest in the world.

Currently, we have domestic companies in both wholesale and retail and a few foreign companies in wholesale and in joint venture (JV) format, with domestic companies, in single brand retail (SBR). In November 2011, we had 300 stores under JV-SBR. Contract farming has also expanded but is still limited, accounting for around 0.7 million hectares area. The number of super market outlets is around 5000. These face intense competition from kirana stores and other domestic retail formats. It is reported that during the last three years, several OR outlets were closed due to several reasons, including non-availability of real estate at prime locations and some state governments' attitude against their entry or continuance, apart from competition from local formats.

The arguments in support of ORs are that (a) they will spend in back-end infrastructure to reduce wastage and remove avoidable losses in the supply chain, (b) they will procure directly from farmers to save transaction costs, (c) they provide sales convenience, assured price/ market to farmers and reduce their marketing risks, (d) they will bring new technology, expertise and modern management practices in retail, (e) they will increase competition and improve marketing efficiency, (f) they will provide more choices, shopping comfort and safer food to the consumers, (g) they will increase investment and thereby step up other economic activities, and (h) they will help increase the sales of micro, small and medium enterprises (MSMEs) at lower costs. Further, big

retailers will help small retailers who will be able to source their supplies from them, as is the experience in India as well as in other developing countries. However, there are quite a few fears being expressed in some quarters. The first fear appears to be that the farmers may be left with a few buyers (i.e. face an oligopsony situation). This is unfounded because the share of ORs may not exceed 15 or 20% of the marketed surplus in the next 15 or 20 years and that is possible if there exists the most favorable conditions for ORs to expand. For the remaining 80% of the marketed surplus, there will continue to be several buyers. The farmers are wise-enough and already on the move to organize into groups for better bargaining with corporate retailers. The second fear is that ORs will maximize their profits. Yes, it is true but they will save avoidable losses and reduce marketing costs and share a part of these with both farmers and consumers. Further, they will face stiff competition. The third fear is that they will do away with kirana stores and hawkers. This is unfounded and has not happened any where in the developing world. The entry of ORs will increase competition but local retailers will continue to exist but with increased efficiency.

Obviously, there are 'arguments in favour' and 'fears against'. The debate and cacophony witnessed in the country on this issue are mainly due to one-sided view taken by both sides.Those who are in favour of the policy refuse to accept that there may be a dark side to it while those who are opposing the policy see none of its positive aspects. On balance, it should be recognized that the opening of super markets or ORs is neither a magic wand to solve all the marketing problems of Indian farmers nor is it an unmitigated disaster. The fears of competition are real but competition is necessary to improve efficiency. Entry of global food giants and others in telecom, automobiles and farm machinery in improving efficiency is sufficient evidence. We should not undermine the ingenuity and acumen of our kirana stores and hawkers. No super market can provide the services our kirana stores and hawkers provide. They do enough business just beyond the exit point of super markets, apart from providing their services to visitors outside temples, office-to-home goers and morning walkers. As ORs have been allowed to be set up with professional circumspection and safeguards,if viewed dispassionately, it is in the overall national interest to encourage the organized sector to enter the farm products retail in a big way. It has and will definitely help the Indian farmers but will not solve all their marketing problems. Actions on many other fronts will be necessary.

Whether small holder farmers benefit from the entry of ORs depends on several factors. Small holder farmers do not form a homogeneous group. Broadly, there are three groups of smallholder farmers viz.: (a) those who are fully commercialized and buy and sell in the markets; (b) those who participate in the market to a limited extent to buy inputs and sell a part of their produce (partially commercialized); and (c) those who are subsistence farmers, selling their labour in the market and buying part of their food needs from the market (net buyers of food grains). Among commercialized small holder farmers, three patterns of market linkages can be identified. First is when farmers are connected to high value export markets either directly or through farmers organizations and other exporters, for example in grapes, baby corn, gherkins, papaya(papain), marigold (oleoresin) and organic crop products. The second group comprises of those small holder farmers who operate in high value domestic markets like potato, onion, milk, and broilers, supplying to wholesalers, modern domestic retailers or 'cash n carry' wholesale players. And the third group includes those who produce cereals, pulses, and oilseeds and sell in domestic markets to wholesalers, state procurement or purchase agencies at pre-announced support or purchase prices. Obviously, the benefits of expansion of ORs will reach small holder farmers to the extent of their commercialization but it may not be automatic.

The experience in India and other developing countries shows that ORs or super market chains prefer to procure from large and medium size farmers or from farmers' groups but this is true for fresh fruits and vegetables. With other items of food and grocery retail, the procurement is generally through open market (APMC yards and wholesale markets), e-choupals, own procurement centres or contracted farmers. Clearly, there is a need to organize the small holder farmers into groups for deriving the potential benefits from expansion of organized retail networks.

The decision to allow FDI in MBR, to 51%, is a very positive step in improving the efficiency of agricultural marketing system. This will accelerate the pace of developing farm gate to consumer linkages. It may be mentioned that the conditions proposed by the government for FDI in MBR are quite comprehensive and take into account the fears in this regard and incorporate the global experience which include the required safeguards. It is proposed to initially allow FDI in 1 million-plus cities (53). A minimum investment of Rs 5 billion, with at least 50% in

back-end infrastructure, is another condition. The farm products will not be allowed to be sold under any brand name and at least 30% of merchandise items will have to be procured from Indian micro, small and medium enterprises (MSMEs). The arguments in favour and against FDI are almost the same as for ORs mentioned before. In addition, as Joint Ventures (JVs) will be necessary, domestic retail and agro-processing companies will benefit. The Indian MSMEs will benefit as they will get technological and investment support from the global retailers. Farmers may also gain access to global markets for such agricultural products in which India has a comparative advantage.

From all angles, this positive move by the government will attract much needed investment in agricultural supply chains. We have in the past opened many sectors and benefited. It is not a panacea but will help increase competition and reduce huge losses in farm products which are bound to hurt both the farmers and the consumers. It should be treated as a win-win situation and not a zero-sum game. Entry of organized retail (domestic or foreign) is a modified form of AMUL model for milk, because cooperative model in other sectors (other than milk and sugarcane/sugar) has not been very successful. However, to make entry of OR in farm commodities successful and creation of a system for them to reach a level of 15 to 20% of marketed surplus, several other measures will be necessary. These include agreement of state governments, massive program of organizing farmers into marketing groups, promoting contract farming arrangements, and comprehensive reformulation of APMR Acts. The small holder farmers will benefit to the extent they are able to organize into groups and participate in several promotional programmes launched in recent years like producer companies, marketing cooperatives, and product or area-based self-help groups for collective marketing efforts. These programmes need to be up-scaled considerably for the benefits of expansion of ORs (domestic or foreign) to reach the small holder farmers in a large measure.

Regional Cooperation for Agricultural Development in South Asia: Achievements and Way Forward

Uttam Deb

Introduction

Agriculture is the most important sector in South Asia. It contributes about one-fifth of the total GDP of South Asia and employs three-fourths of the total labour force. While agricultural population constitutes two-third of the total population in South Asia, the performance of this sector plays an important role in economic growth and food security at the national and household levels. Over the last five decades South Asian agriculture has grown continuously with some ups and downs mainly caused by the weather conditions. Food grain production had increased from 172 million tons in 1970 to more than 400 million tons in 2010. During the same period, milk production had increased from 32 million tons to 172 million tons, and meat from 3.7 million tons to 17.6 million tons. Increased production has enhanced food security both in terms of availability and consumption. While it is widely accepted that increased production is essential for reducing hunger and ensuring food security for all, the defining factors for this yield increase in South Asia are the development and diffusion of modern agricultural technologies.

South Asian agriculture has great potential to prosper through cooperation among countries. The South Asian Association for Regional Cooperation (SAARC) has always been committed to the development of regional agriculture through cooperation since its inception in 1985. In this short note, I would like to focus on the achievements in regional cooperation under SAARC and suggest some measures to promote cooperation for agricultural development among South Asian countries.

Performance of South Asian Agriculture

Agriculture and overall economic growth in all the South Asian countries during the last three decades was very impressive. Till date, crop is the dominant sub-sector among all the sub-sectors of agriculture. South Asian countries have been experiencing a general decline in the share of the

agricultural sector to their GDP with expansion of industry and services sectors. This decline is varying between 13 to 35% in recent years, depending upon the country within the region.

Cereal production has experienced a high growth over time, whereas, production of pulses experienced a slow growth in most of the countries and declined or stagnated in others. South Asia as a region is deficit in pulses and oilseeds production. This shortfall in pulses is met through import of chickpea from Australia and Canada, and pigeon pea from east African countries such as Tanzania, Kenya and Ethiopia. Deficit in oilseeds are met through import of crude soybean oils from Brazil and Argentina and palm oil from Malaysia.

South Asia has gradually diversified in favour of high value enterprises, namely fruits, vegetables, livestock and fishery products. However, the level of diversification varies across countries. The study also revealed that crop diversification was coming from area expansion, with some exception of crop substitution in India and Sri Lanka. Incidentally, in Nepal, Pakistan and Sri Lanka, area expansion is also coming from deforestation, which is a cause of concern from environmental point of view (Joshi et al. 2002).

Agricultural trade among South Asian countries has experienced a switch-on and switch-off situation. Agriculture has been liberalised to a large extent with occasional restriction on export of various agricultural commodities which include rice, wheat, onion and potato to neutralize the rising prices in the domestic market. Applied tariff has been reduced substantially over time for majority of agricultural commodities. Potential for agricultural trade is high among South Asian countries.

Sources of livelihood for rural population in India and Bangladesh have been changing rapidly in the last decade. Real wages for both agriculture and non-agricultural workers have increased. Per capita real income of the villagers has increased over time. Role of non-farm income and remittances as a source of livelihood has increased. In the 1970s and 1980s, villages were growing very slowly in terms of per capita income, diversification of income sources and cropping pattern. There is a substantial decline in poverty level particularly in the recent past. Farmers are now more responsive to the prices, policies and opportunities created to improved technologies and better market access (Deb, 2005; Deb, Bantilan and Anupama, 2011; Hossain and Bayes, 2010).

Economic growth in the villages and rapid urbanization has created additional demand for agricultural products. Projected growth in demand in South Asia in 2025 will exceed by 2% for vegetables, fruits, milk and meat versus (around) 1% for cereals and 1.3% for pulses and oilseeds (Mruthyunjaya and Kumar 2010).

Achievements in Regional Cooperation

SAARC has limited achievements in cooperation for agricultural development. SAARC Agricultural Information Centre (SAIC) was established in Dhaka in 1988 with the mandate to serve as a central information institution. The SAIC was renamed as SAARC Agricultural Centre (SAC) with a broader mandate for agricultural development in South Asia in 2007. The Centre has successfully prepared directories of agricultural institutions and scientists and developed useful databases on a number of crops and agricultural topics including potato, fish diseases, biotechnology, post-harvest technology, renewable energy resources, improved equipment, problem soils, transfer of technology, hybrid and high yielding crops and innovative technologies.

The SAARC Food Security Reserve was established on 12 August 1988 to generate a reserve of foodgrains that can meet emergencies in member countries. To expedite the functions of the SAARC Food Security Reserve and make it more effective, the 12th SAARC Summit declaration recommended the establishment of a Regional Food Bank.

SAARC Agriculture Ministers took common position in various World Food Summits held in Rome in 1996 and 2002. SAARC is yet to take common positions for agricultural trade negotiations held at the World Trade Organization (WTO). Networking among agricultural scientists has been strengthened through the establishment of 12 networks for various crops and disciplines. These are: rice and millet, wheat, oilseeds, horticulture (potato, vegetables and fruits), fisheries, forestry, transfer of technology, livestock (animal health and production), farm machinery and implements, post-harvest technology, agriculture economics and policies, and soils. Progress has been made towards establishing a network on amelioration of problem soils.

Technical Committees on Agriculture and Rural Development (TCARD) of the SAARC has developed SAARC Agriculture Vision 2020 in 2008. It has identified the major challenges for agriculture in the region: raise and sustain agriculture growth; ensure food and nutrition security;

to face the challenge of climate change; adjust to changes in energy scenario; maintain bio-safety and bio-security; make sustainable use of natural resources; and protect bio-diversity. The document has rightly mentioned that new opportunities lie in trade, marketing, bio-technology, shifting demand preferences in domestic and global market, technology sharing, resource-sharing and investments in research, extension and infrastructure. It has rightly observed that SAARC countries need to develop science-based strategy for collective response to challenges, opportunities and global shocks. To that end, on a priority basis, a consensus is to be arrived at on identified areas for cooperation in agriculture; and then form partnership and institutional mechanisms to operationalize regional cooperation. Concrete areas for cooperation and action in agriculture sector within the existing SAARC arrangements should be put in place with focused strategy.

Institutional Capacity, Investment and Research Priorities

South Asian countries have good strength in agricultural research and development activities. According to a recent report of the SAARC Agriculture Centre (SAC 2012), 167 public agencies have been conducting agricultural R&D in India, 123 in Pakistan, 54 in Bangladesh, 20 in Sri Lanka and 8 in Nepal. They have differences in size and structure. However, there are some similarities regarding organization and coordination of national agricultural R&D systems across the five countries. All the units have national agricultural research councils that coordinate agricultural R&D, set priorities, and administer competitive grant schemes, although their roles and scope of authority vary and some are undergoing a change.

Government spending on South Asian agriculture has been on the rise in recent years. According to a newly published report (Stads and Rahija 2012) by Agricultural Science and Technology Indicators (ASTI) and IFPRI, total public agricultural R&D spending (in 2005 PPP dollars) in five South Asian countries (Bangladesh, India, Nepal, Pakistan and Sri Lanka) has more than doubled between 1996 and 2009, while the number of agricultural researchers decreased by 6%. The R&D spending has increased from 1,271 million in 1996 to 2,634 million in 2009. In 2009, investment of India reached to $2.3 billion. Compared to India, Bangladesh, Nepal, Pakistan and Sri Lanka face greater challenges in agricultural R&D. Relative spending levels are lower in India, and year-to-year fluctuations in funding are extreme due to greater donor

dependency. Agricultural R&D intensity ratios in Pakistan (0.21) and Nepal (0.23) are among the lowest in the developing world, and even India (0.40) invests a considerably lower share of its agricultural output on agricultural R&D when compared to other emerging economies such as China (0.50 in 2008) and Brazil (1.80 in 2006). These indicators are a clear sign that South Asia is under investing in agricultural research.

Private sector has been playing an increasingly important role in agricultural R&D investment in South Asia particularly in Bangladesh, India, and Pakistan (Naseem et al. 2012; Pray and Nagarajan 2012; Rashid, Ali and Gisselquist 2012). They are engaged in the development and delivery of hybrid seed. Increased demand for agricultural outputs, national policies conducive to private-sector investment have been resulting in growing involvement of the private sector in agricultural R&D.

Agriculture has special characteristics and location specificity for production of various crops and animals. Therefore, necessary conditions for effective regional cooperation include existence of similar agro-eco-regions, socio-economic conditions and common goals to be achieved. South Asia has six major agro-eco-regions (AERs): (i) Hot Arid, (ii) Semi-Arid, (iii) Irrigated Sub-Humid, (iv) High Rainfall Humid, (v) Sub-Humid to Humid Coasts, and (vi) Sub-Humid to Cold Arid Mountains. Regional spread, climate, major cropping systems and economic significance of these AERs are mentioned in Mruthyunjaya et al (2003). Among these, three AERs (Semi-Arid, High Rainfall Humid and Irrigated Sub-Humid) are quite large and occupy 38.1%, 26.4% and 19% respectively of the total net sown area in South Asia. Each of these three regions contribute more than one-fourth of total value of agricultural output in South Asia. On the other hand, three other AERs (Hot Arid, Sub-Humid to Humid Coastal and Sub-Humid to Cold Arid Mountain) together occupy 16.5% of net sown area and 19.38% of value of agriculture output. Plans and programmes for cooperation among SAARC countries can be based on these regions.

Mrithuynjaya (2012) identified priorities for South Asian agriculture. Throughout South Asia, rice, maize, wheat, pulses, oilseeds, and milk are identified as priority commodities along with horticulture (flowers, fruits and vegetables) and livestock including poultry and fishery. To support high-value agriculture, particularly the growing livestock sector, increasing the fodder supply has also been identified as a regional priority. Other priority areas include natural resources management, adaptation to climate change, resources conservation, and efficient use of water; management of genetic resources and farm mechanization. Another overarching regional priority is to benefit from high-value agriculture covering perishable commodities and from good marketing, processing, postharvest management and value addition with an emphasis on food and biosafety safeguards.

Way Forward

To meet the growing demand for agricultural commodities with lesser land availability, water and other inputs, South Asia will have to depend on the development of new technologies with higher yield. Cooperation among countries under SAARC will help to face this challenge. It is well known that agricultural technologies generated in South Asia in the 20th century were in most cases developed through the partnership of public institutes at the national level and international agricultural research institutes. Role of private sector and NGOs in agricultural technology development and dissemination in South Asia has increased in recent years.

To materialize SAARC Agriculture Vision 2020, SAARC will have to develop joint projects to be implemented by the member countries. Projects should be developed for: (i) establishment of a SAARC Variety Release System to reduce time lag in the release of cultivars (Deb, 2012 for details), (ii) harmonisation of policies and acts, particularly protection of plant variety, bio-safety protocols, biodiversity and indigenous knowledge, (iii) capacity building through fellowship for higher studies in SAARC countries and development of regional facilities particularly the SPS compliant facilities and certification system for organic farming and promotion of environmental goods, (iv) establishment of SAARC funds for agricultural development, (v) development of flagship program with CGIAR institutes, and (vi) promotion of free trade in agricultural commodities among SAARC countries.

SAARC needs to develop flagship programs and delineate strategies for partnership and coordination with CGIAR. At present, all the SAARC countries have formal links and programmes with international organisations like FAO, IFAD and CGIAR research institutes like IRRI, ICRISAT, CIMMYT and World Fish Center. Considering potential for research and technology spillovers, greater efficiencies may be achieved if SAARC can act together for agricultural development in South Asia. In addition, establishment of common fund for SAARC agriculture will allow SAARC Secretariat to formulate and implement joint projects among member countries.

South Asia can be benefited from the experiences of ASEAN particularly in areas such as organisational structure of cooperation, areas of cooperation, preparation of work plan and strategy and development of coordination system and national focal point. SAARC can also learn from implementation mechanism, monitoring and evaluation system, funding strategy, partnership and coordination with third party especially with international agricultural research centres followed by ASEAN (Deb, 2006).

Effective cooperation for agricultural development in South Asia would essentially require: (a) enhanced effectiveness and number of working bodies and networks, (b) develop detailed work programmes, (c) prepare series of agreements on specific issues, (d) regular monitoring and evaluation system, (e) strengthening of existing organisations such as SAARC Agricultural Centre, (f) establishment of regional institutes (designate existing institutes with regional mandates). Most importantly, agricultural development strategy ought to be implemented through public-private-NGO partnership rather than through public agencies only.

References

Deb U. 2005. Trade Liberalisation and Bangladesh Agriculture: Impacts on Cropping Pattern, Resource Use Efficiency and Effective Incentives. A Report prepared at the Centre for Policy Dialogue (CPD) under Research Program IV of the South Asia Network of Economic research Institutes (SANEI). Mimeo.

Deb U. 2006. Regional Cooperation for Agricultural Development in South Asia: A Perspective from Bangladesh. Chapter 9, pages 289-322, in Regional Cooperation in South Asia: A Review of Bangladesh's

Development 2004. Dhaka: University Press Limited (UPL) and the Centre for Policy Dialogue (CPD).

Deb U. 2012. Agricultural Research and Technology Development under SAARC. Pages 264-267, in *Global Recover, New Risks and Sustainable Growth: Repositioning South Asia* (Debapriya Bhattacharya and Mustafizur Rahman, ed). Dhaka: Centre for Policy Dialogue.

Deb U, Bantilan MCS and Anupama GV. 2011. Drivers of Change: Dynamics of Rural Livelihoods and Poverty in SAT India. Paper presented at the Researchers Review Meeting on "Prospects of Indian Agriculture and Rural Poverty Reduction" held at the India International Centre, New Delhi on 27 April 2011; organized by Centennial India.

Hossain M and Bayes Abdul. 2010. Rural Economy and Livelihoods: Insights from Bangladesh. Dhaka: A H Development Publishing House.

Joshi PK and Ashok Gulati. 2002. Agricultural Diversification in South Asia and India. Paper presented at workshop on "Agricultural Diversification in South Asia", organised by Ministry of Agriculture (Bhutan), National Center for Agricultural Economics and Policy Research-NCAP (New Delhi, India) and International Food Policy Research Institute (IFPRI), held in Paro, Bhutan on November 21-23, 2002.

Mruthyunjaya. 2012. Prioritization of Agricultural Research for Development in South-Asia. Report Prepared for International Food Policy Research Institute (IFPRI) and Asia-Pacific Association of Agricultural Research Institutions (APAARI).

Mruthyunjaya and Kumar P. 2010. GCARD Regional Review for Asia Pacific, South Asia Report. Asia-Pacific Association of Agricultural Research Institutions, Asian Development Bank, and Global Forum for Agricultural Research.

Mruthyunjaya, Suresh Pal and Raka Saxena. 2003. Agricultural Research Priorities for South Asia. Policy Paper 20. New Delhi: National Centre for Agricultural Economics and Policy Research.

Naseem A, Nagarajan L, Mudasser **M** and Qureshi F. 2012. Private Agricultural Research and Innovation in Pakistan. Montreal, QC; Washington, DC; and New Brunswick, NJ: McGill University, International Food Policy Research Institute, and Rutgers University.

Pray C and Nagarajan L. 2012. Innovation and Research by Private Agribusiness in India. IFPRI Discussion Paper No. 1181. Washington, D.C. International Food Policy Research Institute.

Rashid R, Ali M and Gisselquist. 2012. Private Innovation and R&D in Bangladesh Agriculture: Description, Impact and Policy Options. Washington, DC: International Food Policy Research Institute and Rutgers University.

SAARC (South Asia Association for Regional Cooperation). 2008. "SAARC Agricultural Vision 2020." Mimeo. New Delhi: National Centre for Agricultural Economics and Policy Research.

SAC (SAARC Agricultural Centre). 2012. NARS-National Agricultural Research Systems in SAARC Countries: An Analysis of System Diversity, Dhaka.

Stads, Gert-Jan and Rahija M. 2012. Public Agricultural R&D in South Asia: Greater Government Commitment, Yet Under investment Persists. International Food Policy Research Institute, Washington, DC and Agricultural Science and Technology Indicators, Rome, Italy.

BIBLIOGRAPHY

Books and book chapters

Bantilan MCS and Padmaja R. 2012. Empowerment of Women and Pathways to Development in the SAT of India: Insights from Gender-based Social Analysis. Pages 10-11 In Program and extended summaries of presentations, Global Conference on Women in Agriculture, 13-15 March, 2012, New Delhi. New Delhi, India: Indian Council of Agricultural Research; and APAARI: Asia Pacific Associations of Agricultural Research Institutions. 2 pgs.

Singh NP, Bantilan MCS, Ashok Kumar A, Janila P and Hassan A. 2011. Climate Change Impacts in South Asia. Pages 68-84 in Crop Adaptation to Climate Change (Yadav SS, Redden B, Hatfield JL and Lotze-Campen H, eds.). John Wiley & Sons Inc, Iowa, USA.

Singh NP, Bantilan MCS and Byjesh K. 2011. Farmers' perception to climate change/variability and adaptive behavior to cope with its impacts – Case studies from SAT villages of India. Pages 180-187 in Agricultural Drought: Climate Change and Rainfed Agriculture. 5th SERC School, Central Research Institute for Dry-land Agriculture, (Rao VUM, Rao, AVMS, Kumar PV, Desai S, Saikia US, Srivastava NN, and Venkateswarulu B, eds.) Hyderabad, India.

Chopde VK, Padmaja R, Bantilan MCS, Dhumale AB and Deb UK. 2011. Ploughing to Prosperity- Kanzara Story. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Birthal PS, Parthasarathy Rao P, Nigam SN, Bantilan MCS and Bhagavatula S. 2010. Groundnut and Soyabean Economies in Asia: Facts, Trends and Outlook. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 92 pp. ISBN: 978-92-9066-531-1. Order code: BOE 050.

Parthasarathy Rao P, Birthal PS, Bhagavatula S and Bantilan MCS . 2010. Chickpea and Pigeonpea Economies in Asia: Facts, Trends and Outlook. Patancheru 502 324, Andhra Pradesh, India:

Ndjeunga J and Bantilan MCS. 2009. Research evaluation and priority assessment at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT): Continuing cycles of learning to improve impacts.

Chapter 6 in Prioritizing Agricultural Research for Development: Experiences and Lessons (Raitzer D and Norton GW eds.). Wallingford ,Oxfordshire, OX10 8DE, UK: CAB International. 256 pp.

Louis V, Meine V, Serigne K, Tomich T, Ong C, Albrecht A, Mackensen J, Bantilan MCS, Anupama KV and Palm C. 2007. Climate Change: Linking Adaptation and Mitigation through Agroforestry. Mitigation and Adaptation Strategies for Global Change. eds. pp 18. Springer, Netherlands.

Ndjeunga J and Bantilan MCS. Productivity Improvement in Marginal Areas in Asia and Africa. Chapter Handbook of Agricultural Economics – Vol. III. MacMillan Press

Bantilan MCS and Keatinge JDH. 2007. Considerations for determining research priorities: Learning cycles, feedback and impact pathways. pp 37-64 in Agricultural Research Management (Loebentein G and Thottapilly G, eds.). Springer, Netherlands. ISSN

Bantilan MCS, Anand Babu P, Anupama KV, Harkar D and Padmaja R. 2006.Dynamics, Priorities and Policies in Dryland Agriculture. Research Bulletin 20. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 28 pp.

Bantilan MCS, Anupama KV and Joshi PK. 2005. Assessing economic and environmental impacts of NRM technologies: An empirical application using economic surplus approach. Chapter 11 in Natural Resource Management in Agriculture: Methods for Assessing Economic and Environmental Impacts (Shiferaw B, Freeman HA, and Swinton S M eds.). Wallingford, UK: CAB International.

Rao KPC, Bantilan MCS, Singh K, Subrahmanyam S, Deshingkar P, Parthasarathy Rao P andShiferaw B. 2005. Overcoming Poverty: Focus on Rainfed Semi-Arid Tropics. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 96 pp

Bantilan MCS and Padmaja R. 2005. Empowerment through social capital build-up: Gender dimensions in technology uptake. Pages 33-34 in Nina Lilja, John Dixon, Guy Manners, Roberto La Rovere, Jonathan Hellin and Hilary Sims Feldstein (eds.). New Avenues in Impact Assessment of Participatory Research and Gender Analysis. Summary Proceedings of the Impact Assessment Workshop, CIMMYT Headquarters, Texcoco, Mexico, October 19-21, 2005.

Bantilan MCS, Deb UK, Reddy BVS, Obilana AB and Gowda CLL (eds.). 2004. Sorghum Genetic Enhancement: Research Process, Dissemination and Impacts. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 320 pp.

Deb UK, Bantilan MCS and Nigam SN. 2005. Impacts of improved groundnut cultivars in India. Pages 141-152 in Impact of Agricultural Research: Post-Green Revolution Evidence from India (Joshi PK, Pal Suresh, Birthal PS and Bantilan MCS, eds.). New Delhi 110 012, India: National Center for Agricultural Economics and Policy Research; Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Deb UK, Bantilan MCS and Rai KN. 2005. Impacts of improved pearl millet cultivars in India. Pages 85-100 in Impact of Agricultural Research: Post-Green Revolution Evidence from India (Joshi PK, Pal Suresh, Birthal PS and Bantilan MCS, eds.). New Delhi 110 012, India: National Center for Agricultural Economics and Policy Research; Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Deb UK, Bantilan MCS and Reddy BVS. 2005. Impacts of improved sorghum cultivars in India. Pages 69-84 in Impact of Agricultural Research: Post-Green Revolution Evidence from India (Joshi PK, Pal Suresh, Birthal PS and Bantilan MCS, eds.). New Delhi 110 012, India: National Center for Agricultural Economics and Policy Research; and Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Deb UK, Bantilan MCS, Bantilan FT and Gowda CLL. 2004. Spillover impacts of sorghum research. Pages 237–260 in Sorghum Genetic Enhancement: Research Process, Dissemination and Impacts (Bantilan MCS, Deb UK, Gowda CLL, Reddy BVS, Obilana AB and Evenson RE, eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Deb UK, Bantilan MCS, Evenson RE and Roy AD. 2004. Productivity impacts of improved sorghum cultivars. Pages 203–221 in Sorghum Genetic Enhancement: Research Process, Dissemination and Impacts (Bantilan MCS, Deb UK, Gowda CLL, Reddy BVS, Obilana AB and Evenson RE, eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Deb UK, Bantilan MCS, Hash CT and Ndjeunga J. 2004. Adoption of improved sorghum cultivars. Pages 181–198 in Sorghum Genetic Enhancement: Research Process, Dissemination and Impacts (Bantilan MCS, Deb UK, Gowda CLL, Reddy BVS, Obilana AB and Evenson RE, eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Deb UK, Bantilan MCS, Reddy BVS, Bramel PJ and Kameswara Rao N. 2004.Impact of improved sorghum cultivars on genetic diversity and yield stability. Pages 225–234 in Sorghum Genetic Enhancement: Research Process, Dissemination and Impacts (Bantilan MCS, Deb UK, Gowda CLL, Reddy BVS, Obilana AB and Evenson RE, eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Deb UK, Bantilan MCS, Roy AD and Parthasarathy Rao P. 2004. Global sorghum production scenario. Pages 21–42 in Sorghum Genetic Enhancement: Research Process, Dissemination and Impacts (Bantilan MCS, Deb UK, Gowda CLL, Reddy BVS, Obilana AB and Evenson RE, eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Bantilan MCS, Deb UK, Gowda CLL, Reddy BVS, Obilana AB and Evenson RE. 2004. Introduction. Pages 5–18 in Sorghum Genetic Enhancement: Research Process, Dissemination and Impacts (Bantilan MCS, Deb UK, Gowda CLL, Reddy BVS, Obilana AB and Evenson RE, eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Bantilan MCS, Deb UK, Gowda CLL, Reddy BVS, Obilana AB and Evenson RE. 2004. Future directions for food security and diversity: partnership and research strategy for sorghum. Pages 263–268 inSorghum Genetic Enhancement: Research Process, Dissemination and Impacts (Bantilan MCS, Deb UK, Gowda CLL, Reddy BVS, Obilana AB and Evenson RE, eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Bantilan MCS and Padmaja R. 2004. Constraints on agriculture productionin South Asia: Role of international collaborative research. Pages 89 to 95 in Prospects for Food Security and Agricultural Sustainability in Developing Regions- New Roles of International Collaborative Research (Miyata S, Tada M, and Koyama O eds.). Proceedings of the 10th JIRCAS International Symposium. JIRCAS

International Symposium Series No 12. Tsukuba, Japan: Japan International Research Center for Agricultural Sciences.

Kameshwara Rao N, Bramel PJ, Gopal Reddy V and Deb UK. 2004. Conservation, utilization and distribution of sorghum germplasm. Pages 43–62 inSorghum Genetic Enhancement: Research Process, Dissemination and Impacts (Bantilan MCS, Deb UK, Gowda CLL, Reddy BVS, Obilana AB and Evenson RE, eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 2004. Managing the turnaround- ICRISAT's external review (Bantilan MCS, Dar WD, Keatinge JDH, Navarro R, Gowda CLL, Nagaraj IR, Chauhan YS, Mehta P, Global Theme Leaders, Hall AH). Patancheru 502 324, Andhra Pradesh, India: ICRISAT. International Crops Research Institute for the Semi-Arid Tropics. 76 pp. ISBN: 978-92-9066-530-4.

Shiferaw B, Bantilan MCS, Gupta SC and Shetty SVR. 2004. Research Spillover Benefits and Experiences in Inter-regional Technology Transfer: An Assessment and Synthesis. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 140 pp.

Shiferaw B, Bantilan C and Serraj R. 2003. Harnessing the potentials of BNF for poor farmers: Technological, policy and institutional constraints and research needs. In: R. Serraj (ed) Symbiotic Nitrogen Fixation: Prospects for Enhanced Application in Tropical Agriculture. Science Publishers.

Shiyani RL, Joshi PK, Asokan M and Bantilan MCS. 2005. Assessment of varietal preferences of chickpea in Gujarat. Pages 131-140 inImpact of Agricultural Research: Post-Green Revolution Evidence from India (Joshi PK, Pal Suresh, Birthal PS and Bantilan MCS, eds.). New Delhi 110 012, India: National Center for Agricultural Economics and Policy Research; and Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Bantilan MCS and Deb UK. 2003. Impacts of genetic enhancement in pearl millet. Pages 215–240 in Crop Variety Improvement and its Effect on Productivity: The impact of International Agricultural Research (Evenson R and Gollin D, eds.). Wallingford, UK: CAB International.

Bantilan MCS, Deb UK and Nigam SN. 2003. Impacts of genetic improvement in groundnut. Pages 293–313 inCrop Variety Improvement and its Effects on Productivity: The Impact of International Agricultural Research (Evenson R and Gollin D, eds.). Wallingford, UK: CAB International.

Bantilan MCS, Parthasarathy D and Padmaja R. 2003. Enhancing research-poverty alleviation linkages: Experiences in the Semi-Arid Tropics. Pages 173-188 in Agricultural Research and Poverty Reduction-Some Issues and Evidence (Shantanu Mathur and Douglas Pachico, eds.). Economics and Impact series 2, Cali, Columbia: International Center for Tropical Agriculture.

Deb UK and Bantilan MCS. 2003. Impacts of genetic improvement in sorghum. Pages 183–213 in Crop Variety Improvement in Sorghum and its Effect on Productivity: The Impact of International Agricultural Research (Evenson R and Gollin D, eds.). Wallingford, UK: CAB International.

Bantilan MCS and Padmaja R. 2003. Strategic assessments of agriculture in the semi-arid tropics: Understanding change. Pages 19-35 in Beyond the Gene Revolution: Sustaining Agricultural Productivity and Enhancing Livelihoods Through Optimization of Crop and Crop-Associated Biodiversity with emphasis on Semi-Arid Tropical Agro-Ecoystems. Proceedings of a workshop, 23-25 September 2002, ICRISAT, Patancheru. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 17 pp.

Joshi PK and Bantilan MCS.2000. Institutionalization of research prioritization, monitoring and evaluation. Pages 65-81 inPriority Setting, Monitoring and Evaluation in Agricultural Research (Suresh Pal and Joshi PK eds.). New Delhi, India: National Center for Agricultural Economics and Policy Research. March 2000. ICRISAT, Patancheru, India.

Bantilan MCS. 2000. Linkages among measurable criteria and sensitivity analysis for research priority setting: Learning from the experience of ICRISAT. Pages 22-34 inPriority Setting, Monitoring and Evaluation in Agricultural Research (Suresh Pal and Joshi, P.K., eds.). New Delhi, India: National Center for Agricultural Economics and Policy Research. March 2000. ICRISAT, Patancheru, India.

Bantilan MCS, Bernal NB, De Castro and Pattugalan J. 1997. Income distribution in the Philippines: 1957-1988: An application of the Dagum

Model to the family income and expenditures survey data. 1996. in Income Distribution, Social Welfare, Inequality and Poverty. (Dagum C. and Lemmi A. (volume eds.), Volume 6, Research on Income Inequality. Slottjee, D.J. (ed) JAI Press, Inc. Greenwich, Connecticut, USA. ISBN 5(1)-5938-864-1.pp.11-44.

Bantilan MCS, Bernal N, Figueroa E and Ledda C. 1997. Measures of poverty and inequality: Estimates and policy options. in Income Distribution, Social Welfare, Inequality and Poverty. (Dagum C. and Lemmi A. (volume eds), Volume 6, Research on Income Inequality. Slottjee, D.J.(ed). JAI Press, Inc., Greenwich, Connecticut, USA. ISBN 5(1)-5938-864-1.pp.55-76.

Evenson REE, Quisumbing A and Bantilan MCS. 1994. Population, technology and rural poverty in the Philippines: Rural income implications from a simple CGE Impact Multiplier Model. Pages 47-72 Perspectives in Philippine Poverty. Center for Integrative and Development Studies, University of the Philippines and Council for Southeast Asian Studies, Yale University, New Haven, Connecticut.

Intal Jr PS and Bantilan MCS. (eds), 1994. Understanding Poverty and Inequity in the Philippines: A Compendium of Policy and Methodological Researches. UNDP/NEDA Publication. United Nations Development Program, National Economic and Development Authority, Pasig, Metro Manila, Philippines, 411 pp. ISBN 971-8535-04-7.

Bantilan MCS. 1994. Methodology for poverty and income distribution analysis: An overview of the DPRP approach. Pages 233-242 in Understanding Poverty and Inequity in the Philippines: Compendium of Policy and Methodological Researches. United Nations Development Program, National Economic and Development Authority, Pasig, Metro Manila, Philippines, 411 pp. ISBN 971-8535-04-7.

Bantilan MCS. 1994. Philippine poverty monitoring systems: Status and future directions. Pages 389-400 in Understanding Poverty and Inequity in the Philippines: Compendium of Policy and Methodological Researches (P.S. Intal Jr. and M.C.S. Bantilan eds.) United Nations Development Program, National Economic and Development Authority, Pasig, Metro Manila, Philippines, 411 pp. ISBN 971-8535-04-7.

Bantilan MCS and Johansen C. 1994. Research evaluation and impact analysis of biological nitrogen fixation. in Ladha JK and Peoples MB (eds.). Management of Biological Nitrogen Fixation for the Development

of More Productive and Sustainable Agricultural Systems. Kluwer Publications. Spuiboulevard 50. Dordrecht, Netherlands. JA 1682.

Bantilan MCS, Bernal N, and De Castro M. 1994. Income distribution and policy options in the Philippines, pages 243-284 in Understanding Poverty and Inequity in the Philippines: Compendium of Policy and Methodological Researches (PS Intal Jr. and MCS Bantilan eds) United Nations Development Program, National Economic and Development Authority, Pasig, Metro Manila, Philippines, 411 pp.
ISBN 971-8535-04-7.

Bantilan MCS, Pattugalan J, and De Castro M. 1994. Adult equivalent income and expenditure distributions: measures of poverty and inequality in the Philippines, pages 311-320 in Understanding Poverty and Inequity in the Philippines: Compendium of Policy and Methodological Researches (P.S. Intal Jr. and M.C.S. Bantilan eds.) United Nations Development Program, National Economic and Development Authority, Pasig, Metro Manila, Philippines, 411 pp. ISBN 971-8535-04-7.

Bantilan MCS and Santos VM. 1992. Income and expenditure distributions in the Philippines: Temporal behavior over three decades, pages 285-310 in Understanding Poverty and Inequity in the Philippines: Compendium of Policy and Methodological Researches (PS Intal Jr. and MCS Bantilan eds) United Nations Development Program, National Economic and Development Authority, Pasig, Metro Manila, Philippines, 411 pp.

Bantilan MCS, Bernal De Castro and Pattugalan. 1992. Income distribution in the Philippines, 1957-1988: An application of the Dagum Model to the family income and expenditures survey (FIES) data, in Dagum C and A Lemmi eds. Personal Income Distribution, Inequality and Poverty, Universita di Siena, Italy, 1992.

Bantilan MCS, Bernal Figueroa and Ledda. 1992. Measures of poverty and inequality: Philippine estimates and policy options, inDagum, C. and A. Lemmi, eds. Personal Income Distribution, Inequality and Poverty, Universita di Siena, Italy, 1992.

Bantilan MCS. 1987. Policy issues in rice crop protection. in Policy Issues on the Philippine Rice Economy and Agricultural Trade, book published by Center for Policy and Development Studies, UPLB, 1987.

Journal Articles

Banerjee R, Kamanda J, Bantilan MCS and Singh NP. 2013. Exploring the relationship between local institutions in SAT India and adaptation to climate variability. Natural Hazards 65:1443–1464 DOI 10.1007/s11069-012-0417-9

Jodha NS, Singh NP and Bantilan MCS. 2012. The commons, communities and climate change. Economic & Political Weekly 47(13): 49-56

Reddy AA and Bantilan MCS. 2012. Competitiveness and technical efficiency: Determinants in the groundnut oil sector of India. Food Policy 37: 255-263.www.elsevier.com/locate/foodpol

Reddy AA and Bantilan MCS. 2012. Regional Disparities in Andhra Pradesh, India. Local Economy 1: 1-13. Sage Publication lec.sagepub.com

Lokesha H, Kiresur VR, Parthasarathy Rao P and Bantilan MCS. 2010. Value chain management in production and marketing of groundnut in Raichur district of Karnataka. Agricultural Economics Research Review, 23: 547

Rao VUM, Manikandan N, Singh NP, Bantilan MCS, Satyanarayana T, Rao AVMS and Rao GGSN. 2009. Trends of heavy rainfall events in Anantpur and Mahabubnagar districts of Andhra Pradesh. Journal of Agrometeorology 11:195-199.

Bantilan MCS and Padmaja R. 2008. Empowerment through social capital build-up: Gender dimensions through technology uptake. Journal of Experimental Agriculture: 44 (1), pp 61-80, 32 Avenue of the Americas, NY 10013-2473, New York, Cambridge University Press.

Gandhi BVJ, Bantilan MCS and Parthasarathy D. 2008. Livelihood risk from HIV in semi-arid tropics of rural Andhra Pradesh. United Nations University, World Institute for Development Economics Research (UNU-WIDER) Publications. 28pp.

Padmaja R and Bantilan MCS. 2008. Gender issues in aquaculture: Learning lessons from International Crops Research Institute for the Semi-Arid Tropics. Development: 51(2), pp 271-277. Society for International Development, Palgrave Mac Milan, Rome, Italy.

Shiferaw B, Bantilan C and Wani S. 2008. Rethinking Policy and institutional imperatives for integrated watershed management: Lessons and experiences from semi-arid India. Journal of Food, Agriculture and Environment 6 (2): 370-377.

Ndjeunga J and Bantilan MCS. 2005. Uptake of improved technologies in the semi-arid tropics of West Africa: Why is agricultural transformation lagging behind? The Electronic Journal of Agricultural and Developmental Economics Vol. 2(1): 85-102

Janaiah A, Achoth L and Bantilan MCS. 2005. Has green revolution by passed coarse cereals? The Indian experience. The Electronic Journal of Agricultural and Developmental Economics 2(1): 20-31

Bantilan MCS, Chandra S, Mehta PK and Keatinge JDH. 2004. Dealing with diversity in scientific outputs: Implications for international research evaluation. Research Evaluation. Vol. 13(2): 87-93.

Shiferaw B and Bantilan C. 2004. Agriculture, rural poverty and natural resource management in less favored environments: Revisiting challenges and conceptual issues. Food, Agriculture & Environment. Vol. 2(1): 328-339.

Brennan JP and Bantilan MCS. 2003. Price and yield effects of spillovers in international agricultural research: Evidence from ICRISAT and Australia. Agricultural Economics 28(2): 87-97.

Shiyani RL, Joshi PK, Asokan M and Bantilan MCS. 2002. Adoption of improved chickpea varieties: KRIBHCO experience in tribal region of Gujarat, India. Agricultural Economics 27(2002): 33-39.

Shiyani RL, Joshi PK, Asokan M and Bantilan MCS. 2000. Adoption of improved chickpea varieties: evidence from tribal regions of Gujarat. Indian Journal of Agricultural Economics 55(2): 159-171. 2000.

Deb UK, Joshi PK and Bantilan MCS. 1999. Impact of modern cultivars on growth and relative variability in sorghum yields in India. Agricultural Economics Research Review 12(2): 84-106. Feb 1999.

Joshi PK, Asokan M and Bantilan MCS. 1999. Silent chickpea revolution in nontraditional areas-some evidences from Andhra Pradesh. India Journal of Agricultural Economics 54(4): 533-544. 1999.

Ramasamy C, Bantilan MCS, Elangovan S and Asokan M. 1999. Perceptions and adoption decisions of farmers in cultivation of improved

pearl millet cultivars-a study in Tamil Nadu.in Indian Journal of Agricultural Economics 54(2): 139-154.

Kolli R and Bantilan MCS. 1997. Gender impact indicators: Implications from on-farm case studies on adoption of groundnut production technologies. Gender, Technology and Development 1(3). New Delhi: Sage Publications.

Bantilan MCS and Johansen C. 1994. Research Evaluation and Impact Analysis of Biological Nitrogen Fixation.Plant and Soil.International Journal on Plant-Soil Relationships.VOL 174, Nos. 1-2, pp. 279-286. JA 1682.

Bantilan MCS, Bantilan FT and De Castro MM. 1992. Fuzzy Set Theory in the Measurement of Poverty. Journal of Philippine Development. Vol. 19, No. 34, pp. 97-122.

Bantilan MCS. 1986. Production Analysis: Econometric Issues. Journal of Philippine Development, Vol. 13, Nos. 1 & 2.

Evenson R, Habito C, Quisumbing A and Bantilan MCS. 1986. Methods for agricultural policy analysis: An overview. Journal of Philippine Development, Vol. 13, Nos. 1 & 2.

Edited Books

Bantilan MCS, Mruthyunjaya, Gowda CLL, and Anupama GV (eds). 2005. Research Need Assessment and Agricultural Research Priorities for South and West Asia: Proceedings of the workshop, 7-8 Oct 2004, ICRISAT Patancheru, India. Asia-Pacific Association of Agricultural Research Institutions, Bangkok, 10200, Thailand; International Crops Research Institute for the Semi-Arid Tropics, Patancheru 502 324, Andhra Pradesh, India; and National Centre for Agricultural Economics and Policy Research, New Delhi, 110 012, India. 148pp.

Joshi PK, Pal Suresh, Birthal PS, and Bantilan MCS (eds). 2005. Impact of Agricultural Research: Post-Green Revolution Evidence from India. National Centre for Agricultural Economics and Policy Research, New Delhi, 110 012, India; and International Crops Research Institute for the Semi-Arid Tropics, Patancheru 502 324, Andhra Pradesh, India.

Bantilan MCS, Parthasarathy Rao P and Padmaja R. (eds.) 2001. Future of agriculture in the semi-arid tropics. Proceedings of an International Symposium on Future of Agriculture in Semi-Arid Tropics, 14 Nov 2000, ICRISAT, Patancheru, India. Patancheru 502 321, Andhra Pradesh, India:

International Crops Research Institute for the Semi-Arid Tropics. 14 Nov. ICRISAT, Patancheru, India. 98 pp.

Bantilan MCS and Joshi PK (eds.). 1998. Assessing joint research impacts. Proceedings of an International Workshop on Joint Impact Assessment of NARS/ICRISAT Technologies for the Semi-Arid Tropics, 2-4 Dec. 1996, ICRISAT, Patancheru, India. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.283 pp.

Bantilan MCS and Joshi PK (eds.). 1997. Integrating research evaluation efforts: Proceedings of the International Workshop on Integrating Research Evaluation Efforts of ICRISAT, the NARS and Other International Research Institutions. 14-16 Dec. 1994, ICRISAT Asia Center, India. (In En. Summaries in En, Fr.) Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 200 pp.

Baidu-Forson J, Bantilan MCS, Debrah SK and Rohrbach DD (eds.). 1996. Partners in impact assessment: Summary proceedings of the ICRISAT/ NARS Workshop on Methods and Joint Impact Targets in Western and Central Africa. 1996. (3-5 May 1995, Sadore, Niger and 9, 11-12 May 1995, Samanko, Mali. (In En., Fr.) Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 116 pp.

Bantilan MCS and Joshi PK (eds.). 1994. Evaluating ICRISAT research impact: Summary proceedings of a Workshop on Research Evaluation and Impact Assessment. 13-15 Dec. 1993, ICRISAT Asia Center, India. (In En. Summaries in En, Fr.) Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 148 pp.

Policy Briefs

Bantilan MCS, Singh NP, Byjesh K, Padmaja R and Jayatilaka W. 2012. Helping communities cope and adapt: Matching climate change perceptions and policy in Asia. Policy brief no. 23. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Suddhiyam P, Wannasai N, Sasiprapa W, Prasertsak P, Koshawatana C, Pratcharoenwanich R, Kumsueb B, Maneechan D, Taveesakvichitchal K, Yoovatana MC, Bantilan MCS and Singh NP. 2012. Mainstreaming grassroots level adaptation and building climate resilient agriculture in Thailand. Policy Brief No. 22. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Deb UK, Bantilan MCS and Singh NP.2012. Mainstreaming grassroots level adaptation and building climate resilient agriculture in SAT Bangladesh. Policy brief no 21. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Niranjan F, Jayatilaka W, Singh NP and Bantilan MCS. 2012. Mainstreaming grassroots level adaptation and building climate resilient agriculture in SAT Bangladesh. Policy brief no 20. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Ha PQ, van The T, van Trinh M, Son NH, Cuong HH, van Bo N, Singh NP and Bantilan MCS. 2012. Mainstreaming grassroots level adaptation and building climate resilient agriculture in SAT Vietnam. Policy brief no 19. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Singh NP, Bantilan MCS, Byjesh K and Murty MVR. 2012. Helping communities adapt: Matching climate change perceptions and policy. RP-MIP Policy brief no 18, Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Singh NP, Bantilan MCS, Byjesh K and Murty MVR. 2012. Climate change realities and policy coherence. RP-MIP Policy brief no 17, Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Kamanda JO, Bantilan MCS, Erkossu Teklu, Pathak Prabhakar and Kai Mausch. 2012. Internationality and public good nature of downstream research: Lessons from ICRISAT's experiences with natural resource management technologies. RP-MIP Policy brief no. 16, Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Nagaraj N, Basavaraj G, Parthasarathy Rao P and Bantilan MCS. 2012. Future outlook and options for target crops: The sorghum and pearl millet economy of India. RP-MIP Policy brief No. 15, Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Amarender Reddy A and Bantilan MCS. 2012. Competitiveness and efficiency in groundnut oil sector of India RP-MIP Policy brief No. 14, Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Parthasarathy Rao P, Agbola F, Bhagavatula S and Bantilan MCS. 2008. Global price trends for ICRISAT mandate crops: Situation and outlook GT-IMPI Policy brief No. 13, Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Reddy VR and Shiferaw B, Bantilan MCS, Wani S and Sreedevi TK. 2007. Collective action for integrated watershed management in semi-arid India: Strategic policy and institutional options. Policy brief No. 11. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Rao KPC, Xavier G, Donald L, Bantilan MCS and Kumara Charyulu D. 2006. How can rainfall insurance help dryland farmers? Policy brief No.7. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 4 pp.

CGIAR Science Council. 2006. Spillover benefits increase returns to sorghum genetic enhancement.Science Council Brief - Standing Panel on Impact Assessment.Released at the CGIAR AGM 2006. Washington DC. Based on a chapter entitled "Spillover Impacts of Sorghum Research" in Sorghum Genetic Enhancement: Research Process, DisseminationandImpacts (Bantilan MCS, Deb UK, Gowda CLL, Reddy BVS, Obilana AB and Evenson RE, eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics Pages 237–260

Bantilan MCS, Rao KPC, Singh K, Parthasarathy Rao P, Shiferaw B and Padmaja R. 2004. Overcoming poverty through dryland agriculture: A strategy for India. Policy Brief 6. Strategic assessment and development pathways for agriculture in the semi-arid tropics. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. April 2003. Patancheru, India. 4 pp.

Bantilan MCS, Rao KPC, Acharya SS, Mruthyunjaya and Padmaja R. 2003. Vision for rainfed agriculture in South Asia. Policy Brief 3. Strategic assessment and development pathways for agriculture in the semi-arid tropics. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. April 2003. Patancheru, India. 4 pp.

Rao KPC, Bantilan MCS, Mohan Rao Y and Chopde VK. 2003. What does village-level evidence suggest for research and development priorities? Policy Brief 4. Srategic assessment and development pathways for agriculture in the semi-arid tropics. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 4 pp.

Research Bulletins

Chopde VK, Padmaja R, Bantilan MCS, Dhumale AB and Deb Uttam. 2012. Dynamics and Development Pathways in the Semi-Arid Tropics: Kanzara Village Profile. Research Bulletin 24. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Nageswara Rao GD, Anand Babu P and Bantilan MCS. 2009. Dynamics and Development Pathways in the Semi-Arid Tropics: Dokur Village Profile. Research Bulletin 23. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 80 pp

Impact Series Publications

Padmaja R, Bantilan MCS, Parthasarathy D and Gandhi BVJ. 2006. Gender and social capital technology uptake. Impact Series No 12. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 48 pp.

Brennan JP, Bantilan MCS, Sharma HC and Reddy BVS. 2004. Impact of ICRISAT research on sorghum midge on Australian agriculture. Impact Series No. 11. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 36 pp.

Joshi PK, Shiyani RL, Bantilan MCS, Pathak P and Nageswara Rao GD. 2002.Impact of vertisol technology in India.Impact Series No. 10. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.40 pp.

Shiyani RL, Joshi PK and Bantilan MCS. 2001. Impact of chickpea research in Gujarat. Impact Series No. 9. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.40 pp.

Ramasamy C, Bantilan MCS, Elangovan S and Asokan M. 2000. Improved cultivars of pearl millet in Tamil Nadu: Adoption, impact, and returns of research investment. Impact Series No. 7. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.60 pp.

Bantilan MCS and Parthasarathy D. 1999. Efficiency and sustainability gains from adoption of short-duration pigeon pea in non-legume-based

cropping systems.Impact Series No. 5. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 1999. ICRISAT, Patancheru, India.28 pp.

Joshi PK and Bantilan MCS. 1998. Impact Assessment of crop and resource management technology: A Case of groundnut production technology. Impact Series No. 2. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 60 pp. ISBN 92-9066-376-6. Order code ISE 002.

Bantilan MCS and Joshi K. 1996. Returns to research and diffusion investments in wilt resistance in Pigeon pea. (In En.Summaries in En, Fr.) Impact Series No. 1. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics, 36 pp. ISBN 92-9066-356-1. ISE 001.

Thesis and Dissertation

Bantilan MCS. 1984. Wealth Uncertainty in a Life Cycle Model. North Carolina State University (Ph.D. dissertation).

Bantilan MCS.1983. Inflation and Pension Benefits. Report to the United States Department of Labor (Contract No.J-9-P-1-0074).

Bantilan MCS. 1977. Statistical Analysis of Philippine Rainfall Data. Written as Research Fellow of the Ford Foundation, Program on the Basin Approach to Water Resources Management, University of the Philippines at Los Banos.

Working Paper Series and Research Reports

Kumara Charyulu D and Bantilan MCS. 2012. Study of Treatment Effects inVillage-level Studies. Working Paper Series No. 33. Patancheru 502 324, Andhra Pradesh,India: International Crops Research Institute for the Semi-Arid Tropics. 54 pp.

Jodha NS, Singh NP and Bantilan MCS. 2012. Enhancing Farmers' Adaptationto Climate Change in Arid and Semi-Arid Agriculture of India: Evidences from Indigenous Practices: Developing International Public Goods from Development-oriented Projects. Working Paper Series No. 32. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 28 pp.

Kamanda JO and Bantilan MCS. 2010. The Strategic Potential of Applied Research: Developing International Public Goods from Development-oriented Projects. Working Paper Series No 26. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 32 pp.

Padmaja R and Bantilan MCS. 2007. Empowerment Through Technology: Gender Dimensions of Social Capital build-up in Maharashtra, India. CAPRi Working paper 63. Washington, DC: International Food Policy Research Institute.

Camara Y, Bantilan MCS and Ndjeunga J. 2005. Impacts of Sorghum and Millet Research in West and Central Africa (WCA): A Synthesis and Lessons Learnt. Socio-Economics and Policy Working Paper Series No. 22. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics

Dadi L, Regassa S, Fikre A, Mitiku D, Gaur PM, Gowda CLL and Bantilan MCS. 2005. Adoption Studies on Improved Chickpea Varieties in Ethiopia. Addis Ababa, Ethiopia: Ethiopian Agricultural Research Organization; and Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Alumira JD, Bantilan MCS and Sihoma-Moyo Tinah. 2005. Evolution of Social Science Research at ICRISAT, and a Case study in Zimbabwe. Socio-Economicsand Policy. Working Paper Series No. 20. PO Box 776, Bulawayo, Zimbabwe: International Crops Research Institute for the Semi-Arid Tropics. 28 pp.

Bantilan MCS, Chandra S, Keatinge D, and Mehta PK. 2004. Research quality at ICRISAT: Separating the Grain from the Chaff. Working Paper Series No. 19. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 52 pp.

Bantilan MCS, Padmaja R, Parthasarathy D, Balakrishnan R and Gandhi BVJ. 2003. Social Analysis: Gender and Social Capital Mediated Technology Adoption. Synthesis report of the workshop on Social analysis, 17-18 July 2003, ICRISAT Patancheru, India. Patancheru 502 324, Andhra Pradesh, India: Global Theme on Sat Futures and Development Pathways, International Crops Research Institute for the Semi-Arid Tropics.

Bantilan MCS, Padmaja R, Balakrishnan R and Gandhi BVJ. 2003. Social Analysis: Gender and Social Capital Mediated Technology Adoption. Synthesis report of the Workshop on Social Analysis. 17-18 July 2003, ICRISAT, Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Bantilan MCS and Anupama KV. 2002. Vulnerability and Adaptation in Dryland Agriculture in India's SAT: Experiences from ICRISAT's Village-Level Studies.Working Paper Series No. 13. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 20 pp.

Aradhyula S, Deb UK, and Bantilan MCS. 2000. Revenue Uncertainty and Enterprise Diversification in the Semi-Arid Tropics of India. Poster-paper presented at the annual conference of the American Agricultural Economics Association, 31 Jul-2 Aug 2000, Tampa, USA. 1 pp.

Badiani R, Dercon S, Krishnan P and Rao KPC. 2007. Changes in Living Standards in Villages in India 1975-2004: Revisiting the ICRISAT Village Level Studies. Chronic Poverty Research Centre, Working paper No. 85, Department of International Development, Oxford, U.K.

Global Theme – Institutions, Markets, Policy and Impacts. 2006. Research Highlights and Future Directions. Prepared for the Centre Commissioned External Review. Vol. 1 Part A (Bantilan MCS, GT-IMPI scientists, and Padmaja R). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 90 pp.

Global Theme – Institutions, Markets, Policy and Impacts. 2006. Research Highlights and Future Directions. Prepared for the Centre Commissioned External Review. Vol. 1 Part B&C (Bantilan MCS, GT-IMPI scientists, and Padmaja R). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 313 pp.

Deb UK and Bantilan MCS. 2001. Spill-over Impacts of Agricultural Research: A review of studies. Socioeconomics and Policy Working Paper Series no. 8. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 32 pp.

Janboonme S, Tippayaruk J, Dhummarangsi P and Bantilan MCS. 2001. Impact of Pigeonpea Research in Enhancing Sugarcane Production in Thailand. Socioeconomics and Policy Working Paper Series 9. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics

Bantilan MCS, Aradhyula S, Padmaja R, Mohan Rao Y, Chopde VK and Nageshwara Rao GD. 2000. Long term Investments in Sub-Saharan Africa and Asia: Village Level Studies – VLS 2001 onwards Investing in the future. Poster presented at the ICW 2000 Donor's Meeting, October 24 2000, Washington, D.C.

Bantilan MCS, Aradhyula S, Padmaja R, Mohan Rao Y, Chopde VK and Nageshwara Rao GD. 2000. Long term Investments in Sub-Saharan Africa and Asia: Village Level Studies – VLS 1975-85 An investment that paid off. Poster presented at the ICW 2000 Donor's Meeting, October 24 2000, Washington, D.C.

Brennan JP and Bantilan MCS. 1999. Impact of ICRISAT Research on Australian Agriculture - Report prepared for the Australian Center for International Agricultural Research. Economic Research Report no. 1, Australia: New South Wales Agriculture. Wagga Wagga, Australia. 52 pp.

Training Manuals

Mohan Rao Y, Ravi Chand K, Kiresur VR and Bantilan MCS. 2011. Documentation of Second-Generation Village Level Studies (VLS) in India (Part I: 2001-02 to 2004-05). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.176 pp

Bantilan MCS, Debbie Templeton and Eric Crasswell. 2010. ACIAR Concepts and Tools for Agricultural Research Evaluation and Impact. Report on Master Class on Impact Assessment, Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. Published by Australian Centre for International Agricultural Research (ACIAR Monograph Series) Canberra Australia. 86 pp.

Padmaja R, Banerjee R, Bantilan MCS and Singh NP. 2009. Vulnerability to Climate Change – Adaptation Strategies and Layers of Resilience. Social analysis using qualitative tools. Training Manual 3. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 36 pp

Ranganathan CR, Singh NP, Bantilan MCS, Padmaja R and Banerjee R. 2009.Vulnerability to Climate Change – Adaptation Strategies and Layers of Resilience. Computation of Vulnerability Indices. Training Manual 2. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Rao GGSN, Rao VUM, Rao AK, Rao AVMS, Singh NP and Bantilan MCS. 2009. Vulnerability to Climate Change – Adaptation Strategies and Layers of Resilience. Agro-climatic analysis. Training Manual 1. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Ndjeunga J, Bantilan MCS, Rao KPC and Ntare BR. 2006. Impact Assessment Manual: Technical notes and exercises. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 60 pp.

Bantilan MCS. 1998. Research evaluation and impact assessment: Training manual. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 99 pp.

Monographs

Bantilan MCS, Debbie Templeton and Eric Crasswell. 2010. ACIAR Concepts and tools for agricultural research evaluation and impact. Report on Master Class on Impact Assessment, Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. Published by Australian Centre for International Agricultural Research (ACIAR Monograph Series) Canberra Australia. 86 pp.

Bantilan MCS and Lantican J. (eds) 1993. Setting Research Priorities for Philippine Agriculture. Department of Agriculture. Bureau of Agricultural Research. Manila, Philippines.

Bantilan MCS. 1992. Elicitation of Subjective Parameters for Research Priorities in Agriculture: Results of Experts Consultation and a Validation Workshop, in Designing Information Systems to Support Research Priority Assessments in Agricultural Research: Concepts and Practices for International and National Level Institutions, J. Davis and J. Ryan, eds. ACIAR Monograph No. 17, 1992.

Bantilan MCS. 1992. Research Priorities: An Application for Agriculture and Fisheries in the Philippines. In Designing Information Systems to Support Priority Assessments in Agricultural Research: Concepts and Practices for International and National Institutions (Davis J.S. and Ryan J.G. eds.) ACIAR Monograph No. 17, 1992. Canberra.

Bantilan MCS. 1992. Estimating Probability of Research Success: Some Theoretical Considerations, in Research Priorities for Philippine

Agriculture. 1992. (M.C.S. Bantilan and J. Lantican (eds.). Department of Agriculture. Quezon City.

Bantilan MCS. 1992. Overall Framework for Agricultural Research Evaluation, in Research Priorities for Philippine Agriculture. 1992. (M.C.S. Bantilan and J. Lantican (eds.). Department of Agriculture. Quezon City.

Bantilan MCS and Carambas N. 1993. Analysis of Research Investments in Philippine Agriculture, ACIAR Working Paper Series. Australian Centre for International Agricultural Research. Canberra.

Bantilan MCS and Carambas N. 1993. Research Infrastructure and Manpower in Philippine Agriculture, ACIAR Working Paper Series. Australian Centre for International Agricultural Research. Canberra.

Bantilan MCS and Carambas N. 1993. Research Expenditures for Philippine Agriculture: Data Base and Some Recent Trends in Regional and Commodity Allocation, forthcoming, ACIAR Working Paper Series. Australian Centre for International Agricultural Research. Canberra.

Bantilan MCS and Corpuz J. 1992. Research Decision-Making Process and Support System in the Philippines, in Designing Information Systems to Support Research Priority Assessments in Agricultural Research: Concepts and Practices for International and National Level Institutions, J. Davis and J. Ryan eds. ACIAR Monograph No. 17. 1992; also published in 1992. Australian Center for International Agricultural Research/ International Service for National Agricultural Research Paper Series. Canberra, Australia.

Bantilan MCS and Davis J. 1992. Opportunity Costs in a Multi-product Production Environment and Across-Commodity Spillover Effects of Research. Published in Australian Center for International Agricultural Research/International Service for National Agricultural Research Paper Series. Canberra, Australia.

Bantilan MCS and Davis J. 1992. Research Production Function and Probability of Success in Agricultural Research Evaluation. In Australian Center for International Agricultural Research/International Service for National Agricultural Research Paper Series. Canberra, Australia; also in Designing Information Systems to Support Research Priority Assessments in Agricultural Research: Concepts and Practices for International and National Level Institutions. J. Davis and J. Ryan eds.1992. ACIAR Monograph No. 17. 1992.

Bantilan MCS and Estrada J. 1992. Supply and Demand Elasticities for Major Agricultural Commodities in the Philippines: National and Regional Estimates. In Australian Center for International Agricultural Research/International Service for National Agricultural Research Paper Series. Canberra, Australia.

Bantilan MCS, Navarro P and Carambas N. 1992. Development of Information Systems to Support Research Priorities in Agricultural Research: An Application for Agriculture and Fisheries in the Philippines, in Designing Information Systems to Support Research Priority Assessments in Agricultural Research: Concepts and Practices for International and National Level Institutions, J. Davis and J. Ryan eds., 1992.

Bantilan MCS. 1990. Agricultural Research Policy: Issues and Process of Formulation. 1990. Monograph No. 7, Southeast Asian Regional Center and Graduate Study and Research in Agriculture. College, Laguna, Philippines.

Bantilan MCS, Olalo C and Espiritu A. 1990. Agricultural Statistics in the Philippines: A Methodological Review. Australian Center for International Agricultural Research/ International Service for National Agricultural Research Paper Series. Canberra, Australia.

Davis J and Bantilan MCS. 1991. Import Replacement and Export Enhancement as an Objective of Agricultural Research Policy: Interpretation and Measurement. Australian Center for International Agricultural Research/International Service for National Agricultural Research Paper Series. Canberra, Australia.

Davis J and Bantilan MCS. 1992. Agricultural Production Response and Cost Structures: Cost Reduction and Output Increasing Linkages for Research Impacts. Published in Australian Center for International Agricultural Research/International Service for National Agricultural Research Paper Series. Canberra, Australia; also in Designing Information Systems to Support Research Priority Assessments in Agricultural Research: Concepts and Practices for International and National Level Institutions. J. Davis and J. Ryan, eds.1992. ACIAR Monograph No. 17. 1992

Davis J, Ryan J and Bantilan MCS. 1992. A Perspective for the Development of Information Systems to Support Research Priorities in Agricultural Research, in Designing Information Systems to Support

Research Priority Assessments in Agricultural Research: Concepts and Practices for International and National Level Institutions, J. Davis and J. Ryan, eds. ACIAR Monograph No. 17, 1992.

Workshop Proceedings

Bantilan MCS and Padmaja R. 2003. Strategic assessments of agriculture in the semi-arid tropics: Understanding change. Pages 19-35 inBeyond the gene revolution: Sustaining agricultural productivity and enhancing livelihoods through optimization of crop and crop-associated biodiversity with emphasis on semi-arid tropical agro-ecoystems. Proceedings of a workshop, 23-25 September 2002, ICRISAT, Patancheru. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 17 pp.

Bantilan MCS, Padmaja R, Parthasarathy D, Balakrishnan R and Gandhi BVJ. 2003. Social analysis: Gender and social capital mediated technology adoption. Synthesis report of the workshop on Social analysis, 17-18 July 2003, ICRISAT Patancheru, India. Patancheru 502 324, Andhra Pradesh, India: Global Theme on Sat Futures and Development Pathways, International Crops Research Institute for the Semi-Arid Tropics.

Bantilan MCS, Parthasarathy Rao P and Padmaja R. (eds.) 2001. Future of agriculture in the semi-arid tropics. Proceedings of an International Symposium on future of agriculture in semi-arid tropics, 14 Nov 2000, ICRISAT, Patancheru, India. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 14 Nov. ICRISAT, Patancheru, India.98 pp.

Bantilan MCS. 2000. Linkages among measurable criteria and sensitivity analysis for research priority setting: Learning from the experience of ICRISAT. Pages 22-34 in Priority Setting, Monitoring and Evaluation in Agricultural Research (Suresh Pal and Joshi, P.K., eds.). New Delhi, India: National Center for Agricultural Economics and Policy Research. March 2000. ICRISAT, Patancheru, India.

Joshi PK and Bantilan MCS. 2000. Institutionalization of research prioritization, monitoring and evaluation. Pages 65-81 in Priority Setting, Monitoring and Evaluation in Agricultural Research (Suresh Pal and Joshi PK eds.). New Delhi, India: National Center for Agricultural Economics and Policy Research. March 2000. ICRISAT, Patancheru, India.

Bantilan MCS, Joshi PK and Lieu P. 1999. Adoption of new technologies for groundnut in India and Vietnam-ICRISAT. Pages 55-59 in A Synthesis of Findings concerning CGIAR case studies on the Adoption of Technological Innovations (Sechrest L, Stewart M, Stickle T, eds.). Rome, Italy: Impact Assessment and Evaluation Group of the CGIAR. May 1999. ICRISAT, Patancheru, India.

Lieu P, Bantilan MCS, Sechrest L, Nguyen Thi Lien Hoa, Ngo Thi Lam Giang, Bui Viet Nu and Duong Hoa Xo. 1999. Adoption of new technologies for groundnut in South Vietnam: assessment using focus group and on-farm surveys. Collaborative project of ICRISAT and National research programs of Vietnam and India funded by the CGIAR (IAEG). 1999. ICRISAT, Patancheru, India. 32 pp.

Ogungbile A, Tabo, R, Gupta SC, Ajayi O and Bantilan MCS. 1999. Factors influencing awareness and adoption of sorghum varieties in Nigeria – ICRISAT. Pages 60-64 in A synthesis of findings concerning CGIAR case studies on the adoption of technological innovations (Sechrest L, Stewart M and Stickle T, eds.). Rome, Italy: Impact Assessment and Evaluation Group of the CGIAR.

Bantilan MCS, Rai KN and Subba Rao KV. 1998. Use of ICRISAT/NARS pearl millet germplasm. Pages 217-223 in Assessing Joint Research Impacts: proceedings of an International Workshop on Joint Impact Assessment of NARS/ICRISAT Technologies for the Semi-Arid Tropics, 2-4 Dec 1996, ICRISAT, Patancheru, India (Bantilan MCS and Joshi PK eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 1998. ICRISAT, Patancheru, India.

Bantilan MCS, Subba Rao KV, Rai KN and Singh D. 1998. Research on high-yielding pearl millet-background for an impact study in India. Pages 52-61 in Assessing Joint Research Impacts: proceedings of an International Workshop on Joint Impact Assessment of NARS/ICRISAT Technologies for the Semi-Arid Tropics, 2-4 Dec 1996, ICRISAT, Patancheru, India (Bantilan MCS and Joshi PK, eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 1998. ICRISAT, Patancheru, India.

Bantilan MCS and Joshi PK (eds). 1998. Joint Research Impacts: Proceedings of Regional Workshop on ICRISAT/NARS Impact Assessment, 2-4 Dec. 1996, ICRISAT Asia Center, India. (In En. Summaries in En, Fr.) Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics, 208 pp.

Bantilan MCS and Parthasarathy D. 1998. Adoption assessment of short-duration pigeonpea ICPL 87. Pages 136-152 in Assessing Joint Research Impacts: proceedings of an International Workshop on Joint Impact Assessment of NARS/ICRISAT Technologies for the Semi-Arid tropics, 2-4 Dec 1996, ICRISAT, Patancheru, India (Bantilan MCS and Joshi PK eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 1998. ICRISAT, Patancheru, India.

Bantilan MCS and Joshi PK (eds.) 1998. Assessing joint research impacts. Proceedings of an International Workshop on Joint Impact Assessment of NARS/ICRISAT Technologies for the Semi-Arid Tropics, 2-4 Dec 1996, ICRISAT, Patancheru, India. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. December 1998. ICRISAT, Patancheru, India.283 pp.

Deb UK and Bantilan MCS. (eds.) 1998. Spillover impacts of sorghum germplasm research. Study undertaken as part of the Research Evaluation and Impact Assessment (REIA) project. December 1998. ICRISAT, Patancheru, India. 250 pp.

Deb UK and Bantilan MCS. 1998. Sorghum database development to enhance technology spillovers. Pages 29-33 in Strengthening Sorghum Research Collaboration in Asia: Report of the Asian Sorghum Scientists' Meeting, 18-21 Nov. 1997, Suphan Buri, Thailand (Gowda CLL and Stenhouse JW, eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. December 1998. ICRISAT, Patancheru, India.

Gowda CLL, Ramakrishna A, Bantilan MCS and Subba Rao KV. 1998. Assessing the impact of CLAN. Pages 254-268 in Assessing Joint Research Impacts: proceedings of an International Workshop on Joint Impact Assessment of NARS/ICRISAT Technologies for the Semi-Arid Tropics, 2-4 Dec. 1996, ICRISAT, Patancheru, India (Bantilan MCS and Joshi PK, eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 1998. ICRISAT, Patancheru, India.

Iranian SKDFF, Bantilan MCS, Joshi PK and Sabena KB. 1998. Evaluating hybrid technology of pigeonpea. Pages 231-240 in Assessing Joint Research Impacts: proceedings of an International Workshop on Joint Impact Assessment of NARS/ICRISAT Technologies for the Semi-Arid Tropics, 2-4 Dec. 1996, ICRISAT, Patancheru, India (Bantilan MCS and Joshi PK, eds.). Patancheru 502 324, Andhra Pradesh, India: International

Crops Research Institute for the Semi-Arid Tropics. 1998. ICRISAT, Patancheru, India.

Joshi PK and Bantilan MCS. 1998. Measuring returns to investment in groundnut production technology. Pages 155-163 in Assessing Joint Research Impacts: proceedings of an International Workshop on Joint Impact Assessment of NARS/ICRISAT Technologies for the Semi-Arid Tropics, 2-4 Dec. 1996, ICRISAT, Patancheru, India (Bantilan MCS and Joshi PK, eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 1998. ICRISAT, Patancheru, India.

Asokan M, Bantilan MCS, Joshi PK, Anders MM and Valasayya S. 1998. Dual-purpose Sorghum – A case study in India. Pages 38-51 in Assessing Joint Research Impacts: proceedings of an International Workshop on Joint Impact Assessment of NARS/ICRISAT Technologies for the Semi-Arid Tropics, 2-4 Dec. 1996, ICRISAT, Patancheru, India (Bantilan MCS and Joshi PK, eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 1998. ICRISAT, Patancheru, India.

Joshi PK, Bantilan MCS, Ramakrishna A, Chopde VK and Raju PSS. 1998. Adoption of vertisol technology in the semi-arid tropics. Pages 182-196 in Assessing Joint Research Impacts: proceedings of an International Workshop on Joint Impact Assessment of NARS/ICRISAT Technologies for the Semi-Arid Tropics, 2-4 Dec. 1996, ICRISAT, Patancheru, India (Bantilan MCS and Joshi PK, eds.). Patancheru 502 324, Andhra Prudish, India: International Crops Research Institute for the Semi-Arid Tropics. 1998. ICRISAT, Patancheru, India.

Joshi PK, Bantilan MCS, Shiyani RL, Asokan M and Sethi SC. 1998. Chickpea in the hot and dry climate of India — adoption and impact of improved varieties. Pages 94-102 in Assessing Joint Research Impacts: proceedings of an International Workshop on Joint Impact Assessment of NARS/ICRISAT Technologies for the Semi-Arid Tropics, 2-4 Dec. 1996, ICRISAT, Patancheru, India (Bantilan MCS and Joshi PK, eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 1998. ICRISAT, Patancheru, India.

Shiyani RL, Joshi PK, Asokan M, Bantilan MCS and Sethi SC. 1998. Adoption of improved chickpea varieties in Panchmahals district of Gujarat. Pages 103-113 in Assessing Joint Research Impacts: proceedings of an International Workshop on Joint Impact Assessment of NARS/

ICRISAT Technologies for the Semi-Arid Tropics, 2-4 Dec. 1996, ICRISAT, Patancheru, India (Bantilan MCS and Joshi PK, eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 1998. ICRISAT, Patancheru, India.

Bantilan MCS. 1997. Integration of Research Evaluation Efforts of ICRISAT with the NARS and Other International Research Institutions: Overview. pp. 1-8 in ICRISAT/NARS Joint Impact: Proceedings of a Workshop on Integrating Research Evaluation Efforts of ICRISAT, the NARS and Other International Research Institutions, 7-10 Dec. 1994, ICRISAT Asia Center, India. (In En. Summaries in En, Fr.) Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics, 208 pp. CP 1082.

Bantilan MCS and Joshi PK. (eds). 1997. Integrating Research Evaluation Efforts: Proceedings of the International Workshop on Integrating Research Evaluation Efforts of ICRISAT, the NARS and Other International Research Institutions. 14-16 Dec. 1994, ICRISAT Asia Center, India. (In En. Summaries in En, Fr.) Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics, 200 pp.

Bantilan MCS and Joshi PK. 1996. Adoption and Impact of Pigeonpea ICP 8863. pp. 39-39. in Partners in Impact Assessment. Summary proceedings of the ICRISAT/NARS Workshop on Methods and Joint Impact Targets in Western and Central Africa. (Baidu-Forson J, Bantilan MCS, Debrah SK and Rohrbach DD. eds.) Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics, 116 pp. CPE/F 107.

Bantilan MCS. 1996. Basic Model and Minimum Data Requirements for Economic Impact: Assessment of Research. 1996. pp. 32-34. in Partners in Impact Assessment. Summary proceedings of the ICRISAT/NARS Workshop on Methods and Joint Impact Targets in Western and Central Africa. (Baidu-Forson J, Bantilan MCS, Debrah SK and Rohrbach DD. eds.) Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics, 116 pp. CPE/F 107.

Bantilan MCS. 1996. Research Evaluation and Impact Assessment: Framework. 1996. pp. 29-31 in Partners in Impact Assessment. Summary proceedings of the ICRISAT/NARS Workshop on Methods and Joint Impact Targets in Western and Central Africa. (Baidu-Forson J, Bantilan MCS, Debrah SK and Rohrbach DD. eds.) Patancheru 502 324, Andhra

Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics, 116 pp. CPE/F 107.

Baidu-Forson J, Bantilan MCS, Debrah SK and Rohrbach DD (eds.). 1996. Partners in Impact Assessment: summary proceedings of the ICRISAT/ NARS Workshop on Methods and Joint Impact Targets in Western and Central Africa. 1996. (3-5 May 1995, Sadore, Niger and 9, 11-12 May 1995, Samanko, Mali. (In En, Fr.) Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics, 116 pp. CPE/F 107.

Joshi PK and Bantilan MCS. 1996. Adoption and Benefits from Improved Soil, Water and Nutrient Management Research. pp. 42-45. in Partners in Impact Assessment. Summary proceedings of the ICRISAT/NARS Workshop on Methods and Joint Impact Targets in Western and Central Africa. (Baidu-Forson J, Bantilan MCS, Debrah SK and Rohrbach DD. eds.) Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics, 116 pp. CPE/F 107.

Bantilan MCS and Joshi PK. (eds). 1994. Evaluating ICRISAT Research Impact: summary proceedings of a Workshop on Research Evaluation and Impact Assessment.13-15 Dec. 1993, ICRISAT Asia Center, India.(In En. Summaries in En, Fr.) Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics, 148 pp. ISBN 92-9066-302-2. CPE 091.

Bantilan MCS. 1994. Research Evaluation and Impact Assessment: Framework and Strategies, pages 73-77 in Evaluating ICRISAT Research Impact: summary proceedings of a Workshop on Research Evaluation and Impact Assessment, 13-15 Dec. 1993, ICRISAT Asia Center, India, (Bantilan MCS and Joshi PK. eds.) Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Bantilan MCS. 1994. Spillover Effects of Agricultural Research, pp. 96-100 in Evaluating ICRISAT Research Impact: Summary proceedings of a Workshop on Research Evaluation and Impact Assessment, 13-15 Dec. 1993, ICRISAT Asia Center, India, (Bantilan MCS and Joshi PK. eds.) Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Bantilan MCS. 1994. Distributional Impact of Research: Sectoral Benefits and Policy Simulation. In Evaluating ICRISAT Research Impact: summary proceedings of a Workshop on Research Evaluation and Impact

Assessment, 13-15 Dec. 1993, ICRISAT Asia Center, India, (Bantilan MCS and Joshi PK. eds.) Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Bantilan MCS and Singh RP. 1994. New Technology and Differential Effects on Employment and Poverty. pages 83-85 in Evaluating ICRISAT Research Impact: summary proceedings of a Workshop on Research Evaluation and Impact Assessment, 13-15 Dec. 1993, ICRISAT Asia Center, India, (Bantilan MCS and Joshi PK. eds.) Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Bantilan MCS, Gowda CLL and Joshi PK. 1994. Impact of the Cereals and Legumes Asia Network. pages 113-116 in Evaluating ICRISAT Research Impact: summary proceedings of a Workshop on Research Evaluation and Impact Assessment, 13-15 Dec. 1993, ICRISAT Asia Center, India, (Bantilan MCS and Joshi PK eds.) Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Bantilan MCS, Johansen C and McDonald D. 1994. Expectations from BNF research: Research administrator's point of view Pages 61-69 in Linking Biological Nitrogen Fixation Research in Asia: Report of a meeting of the Asia Working Group on Biological Nitrogen Fixation in Legumes, 6-8 Dec, ICRISAT Asia Center, India, (Rupela OP, Kumar Rao JVDK, Wani SP and Johansen C. eds.) Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. CP 914.

Bantilan MCS. 1993. Technology Adoption and Economic Assessment of On-farm Adaptive Research, pp. 21-27. In Approaches to On-farm Research in Asia: Summary proceedings of a Regional Workshop on On-farm Adaptive Research, 18-20 Feb. 1993, Ho Chi Minh City, Vietnam, (Gowda CLL, Van Santen CE, Johansen C and Nigam SN. eds.) Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 153 pp. ISBN 92-9066-278-6. CPE 085.

Posters / Poster Papers

Bantilan MCS and Naveen P Singh. 2013. Building Resilient Crops and Resilient Systems - Hearing the Unheard Voices of the Poor. Organized a side event and presented poster exhibit during "High Level Meeting on

National Drought Policy (HMNDP)", International Conference Centre (CIGG), Geneva, 12 March 2013.

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 2009. Vulnerability to Climate Change: Adaptation Strategies and Layers of Resilience – Project objectives. Poster for display

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 2009. Vulnerability and Adaptation to Climate Change in the SAT Region: A Conceptual Framework. Poster for display

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 2009. Vulnerability to Climate Change: Adaptation Strategies and Layers of Resilience – Overview. Poster for display

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 2007. Pigeonpea Technology Adoption and Impact in Kenya and Tanzania. Poster paper Prepared for the ICRISAT Governing Board meeting in Lilongwe, Malawi, 22-25 Oct 2007.

Bantilan MCS and Padmaja R. 2002. The Difference We Make. ICRISAT Research on the Well-being of Women. Poster for display.

Bantilan MCS and Padmaja R. 2002. Fighting Poverty: a War on many Fronts. A Challenge of the New Millennium: Less Poverty, More Ggrowth. Poster for display.

Bantilan MCS, Anupama KV and Padmaja R. 2002. Securing Agriculture in South Asia and Sub-Saharan Africa. Poster for display.

Parthasarathy D, Chopde VK, Bantilan MCS and Padmaja R. 2001. Building Social Capital: Collective Action, Adoption of Agricultural Innovations, and Poverty Reduction in the Indian SAT. Poster for display.

Bantilan MCS, Aradhyula S, Padmaja R, Mohan Rao Y, Chopde VK and Nageshwara Rao GD. 2000. Long Term Investments in Sub-Saharan Africa and Asia: Village Level Studies – VLS 2001 onwards Investing in the Future. Poster presented at the ICW 2000 Donor's Meeting, October 24 2000, Washington, D.C.

Bantilan MCS, Deb UK and Singh SD. 2000. Farm-level Genetic Diversity in Pearl Millet in India: Poster paper presented at the 3rd International Crop Science Congress, 18-22 Aug 2000, Hamburg, Germany .1 pp.

Aradhyula S, Deb UK and Bantilan MCS. 2000. Revenue uncertainty and enterprise diversification in the Semi-Arid Tropics of India: Poster-

paper presented at the annual conference of the American Agricultural Economics Association, 31 Jul-2 Aug 2000, Tampa, USA. 1 pp.

Bantilan MCS and Parthasarathy D. 1996. Efficiency and Sustainability Gains from Adoption of Short-duration Pigeonpeas in Non-legume Based Cropping Systems. Poster presented at the 9th Conference of the International Soil Conservation Organization, Bonn, Aug 26-30, 1996 and at the VIII Congress of the European Association of Agricultural Economists, Edinburg, Sep 3-9, 1996.

Impact Updates, Pocket books, CD-ROMs and Newsletters

ICRISAT-RP-MIP. 2012. Reflections from the Grassroots for a Climate Smart Agriculture: Act now, Act together and Act differently. A Short film. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Siddappa A, Mohan Rao Y, Kiresur VR and Bantilan MCS. 2012. Pamidipadu Village – At a Glance. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Ramesh G, Mohan Rao Y, Kiresur VR and Bantilan MCS. 2012. JC Agraharam Village – At a Glance. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Desai TS, Nageswara Rao GD, Kiresur VR and Bantilan MCS. 2012. Markabinahalli Village – At a Glance. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Pandey PR, Mohan Rao Y, Kiresur VR and Bantilan MCS. 2012. Rampura Kalan Village – At a Glance. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Dayanand N, Mohan Rao Y, Kiresur VR and Bantilan MCS. 2012. Papda Village – At a Glance. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Anil Kumar Yadav KN, Dayanand N, Nageswara Rao GD, Kiresur VR and Bantilan MCS. 2012. Belladamadugu Village – At a Glance. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Bangar PR, Chopde VK, Kiresur VR and Bantilan MCS. 2011. Kalman Village – At a Glance. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Dhumale AB, Chopde VK, Kiresur VR and Bantilan MCS. 2011. Kanzara Village – At a Glance. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Duche VD, Chopde VK, Kiresur VR and Bantilan MCS. 2011. Shirapur Village – At a Glance. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Likhitkar LS, Chopde VK, Kiresur VR and Bantilan MCS. 2011. Kinkhed Village – At a Glance. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Rama Krishna N, Mohan Rao Y, Kiresur VR and Bantilan MCS. 2011. Dokur Village – At a Glance. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Ramana Reddy K, Mohan Rao Y, Kiresur VR and Bantilan MCS. 2011. Aurepalle Village – At a Glance. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

ICRISAT-GT-IMPI and CRIDA. 2009. Agro-Climatic Analysis. CD-ROMs. Patancheru 502 324, Andhra Pradesh, India.

ICRISAT-GT-IMPI, ACIAR and The Crawford Fund. 2009. Research Evaluation and Impact Assessment – Training Modules. CD-ROMs. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

ICRISAT-GT-IMPI. 2009. Computation of Vulnerability Indices. CD-ROMs. Patancheru 502 324, Andhra Pradesh, India.

Ndjeunga J and Bantilan MCS. 2007. Research Priority Setting at ICRISAT. ICRISAT report to Standing Panel for Impact Assessment, CGIAR.

Parthasarthy Rao P and Bantilan MCS. 2007. Agricultural Commodity Prices Looking Up. SAT trends No. 85. Patancheru 502324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Bantilan MCS. 2007. Impact Pathway Analysis. Lecture delivered during WCA In-House Review, Niger, June 2007.

Bantilan MCS. 2007. Research Innovation, adoption and impact cycle. Lecture delivered on 6 December 2007, document and Power Point presentation to the participants of the ICRISAT-CRIDA training programme on "Farming System Approach for Livelihood Improvement of Rainfed Farmers", held at ICRISAT, Patancheru. (About 30 participants from different Agricultural Research Institutes and Universities across India.)

GT-IMPI. 2007. GT-IMPI Information brochure. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 6 pp.

GT-IMPI. 2007. Village-Level Studies. Information Portal. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

GT-IMPI. 2007. VLS-Reaching the Unreached. Video documentary. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 2007. Dryland Development Pathways. What ICRISAT Thinks. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 4 pp.

ICRISAT. 2005. ICRISAT Impacts Update. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 47 pp.

ICRISAT. 2004. ICRISAT Research Impacts: Pocket Book. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

GT-SAT Futures, ICRISAT and APAARI. 2004. Proceedings of an International workshop on "Research Need Assessment and Prioritization of Agricultural Research for Development in South and West Asia." 7-8 October, 2004, International Crops Research Institute for the Semi-Arid Tropics.

GT-SAT Futures, ICRISAT. 2004. Impact Assessment of Agricultural Technologies in West Africa. Training Workshop, 12-16 July, 2004. Bamako, Mali: International Crops Research Institute for the Semi-Arid Tropics.

GT-SAT Futures, ICRISAT. 2004. Together We Sow, Together We Reap. Video documentary featuring the process of empowerment. International Crops Research Institute for the Semi-Arid Tropics.

Bantilan MCS. 2003. Social Capital: An Exit Path from Poverty. ICRISAT success story flyer. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Bantilan MCS. 2003. Social capital: An Exit Path from Poverty. ICRISAT success story flyer. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

GT6-ICRISAT. 2002. ICAR-ICRISAT Workshop on Vision for Rainfed Agriculture in South Asia: Targeting Research for Development. Compilation of papers and presentations at the workshop, 2-4 Dec 2002. CD-ROM. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 2001. ICRISAT Research Impacts: For Informed Research Targets and Technology Design. Pocket Book. Patancheru 502 324, Andhra Pradesh, India: ICRISAT.

REIA Team, ICRISAT. 2001. Adoption and Impact Monitoring Updates – release 2. Patancheru 502 324, Andhra Pradesh India: International Crops Research Institute for the Semi-Arid Tropics. 44 pp

SEPP-ICRISAT. 2001. SAT Futures Database. CD-ROM. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

ICRISAT/SEPP. 2001. ICRISAT Research Impacts. Pocket book. 20 pp.

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics).2000. ICRISAT Research Impacts and Future Challenges. Brochure. Patancheru 502 324, Andhra Pradesh, India: ICRISAT.

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics).2000. ICRISAT Research – Impacts Achieved and Challenges Ahead.Poster cum flyer. Patancheru 502 324, Andhra Pradesh, India: ICRISAT.

ICRISAT/SEPP. 2000. ICRISAT Research, Impacts Achieved and Challenges Ahead: Poster cum folder. Patancheru 502 324, Andhra

Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 8 pp.

ICRISAT/SEPP. 2000. ICRISAT Research, Impacts Achieved and Challenges Ahead: Poster cum folder. 8 pp.

ICRISAT/SEPP. 2000. ICRISAT Research, Impacts and Future Challenges: Booklet. 46 pp.

ICRISAT/SEPP. 2000. Impacts of ICRISAT-NARS research in Africa: Flyer, Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics .8 pp.

ICRISAT/SEPP. 2000. Long-term Investments in Sub-Saharan Africa and Asia: ICRISAT Village-Level Studies: Flyer, Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 8 pp.

REIATeam, ICRISAT. 2000. Adoption and Impact Monitoring Updates – release 1. Patancheru 502 324, Andhra Pradesh India: International Crops Research Institute for the Semi-Arid Tropics. 40 pp

SEPP-ICRISAT. 2000. Socio-economics and Policy Program Databases – Village Level Studies, Research Evaluation and Impact Assessment and District Level Studies. CD-ROM. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

ICRISAT/ACIAR. 1999. Training modules on Research Evaluation and Impact Assessment: CD-ROM. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Conference papers, newspaper articles and newsletters

Bantilan MCS and Padmaja R. 2012. Building Resilience for Climate Change in Agriculture: Perspectives from a Gender and Network Lens from the Semi-Arid Tropics of India. Paper presented at symposium on "Agriculture Innovations for Gender Empowerment" during the Third International Agronomy Congress on "Agriculture, Diversification, Climate Change Management and Livelihoods", 26-30 November, 2012 to be held at IARI, New Delhi, 110 012.

Padmaja R, Bantilan MCS, Parthasarathy D and Singh NP. 2011. Mapping Village Social Networks to Analyze Vulnerability to Climate Variability

and Adaptive Capacity in the Semi-Arid Tropics of India. Paper presented at the ICARUS-II conference, Michigan University, USA.

Binswanger Hans P, Lalmani Pandey, Parthasarathy Rao P and Bantilan MCS. 2011. Supply Response and Investments in Agriculture in Andhra Pradesh. Paper presented at the Workshop on "Prospects of Indian Agriculture and Rural Poverty Reduction" held on 28-29 April 2011 in New Delhi; organized by Centennial India.

Deb Uttam, Bantilan C and Anupama GV. 2011. Drivers of Change: Dynamics of Rural Livelihoods and Poverty in SAT India. Paper presented at the Researchers Review Meeting on "Prospects of Indian Agriculture and Rural Poverty Reduction" held at the India International Centre, New Delhi on 27 April 2011; organized by Centennial India.

Mausch K and Bantilan MCS. 2011. Definition of Homogeneous Groundnut Production Domains – A Tool to Assess Transferability and Spillover Effects from ICRISAT Groundnut Technologies, paper accepted for presentation and publication in the conference proceedings of 13th International Conference of the International Association of the Study of the Commons, 10-14 January 2011, Hyderabad.

Pandey LM, Parthasarathy Rao P, Binswanger HP and Bantilan MCS. 2011. Supply Response and Investment in Agriculture in Andhra Pradesh. Paper presented at the workshop on prospects of Indian agriculture and rural poverty reduction, 27-29 April 2011, New Delhi. Centennial Development Advisory Service India Limited.

Mausch K, Bantilan MCS and Babu A. 2010. Spillover Effects from Agricultural Research. Laying the Foundation for Quantification of ICRISAT Efforts. Poster presented at Tropentag 2010, Zurich.

Rao GGSN, Singh NP, Bantilan MCS, Manikandan N, Rao VUM, Satyanrayana T and Rao AVMS. 2009. Variability of Rainfall and Cropping Pattern Changes of major Kharif Crops in the Semi-AridTropics of India: A case study of Anantapur and Mahabubnagar districts of Andhra Pradesh state in International workshop on Impact of Climate Change on Agriculture, 17-18 December 2009, SAC, Ahmedabad, India.

Rao VUM, Manikandan N, Singh NP, Bantilan MCS, Satyanarayana T, Rao AVMS and Rao GGSN. 2009. Trends of Heavy Rainfall Events in Anathapur and Mahabubnagar districts of Andhra Pradesh in National seminar on Agrometeorology-Needs, Approaches and Linkages for Rural Development, 26-27 November 2009, ISRO, Hisar, India.

Singh NP and Bantilan MCS. 2009. Climate Change Resilience in Agriculture: Vulnerability and Adaptation Concerns of Ssemi-Arid Tropics in Asia. Pages 189-236 in Proceedings of the Indo-US workshop on Emerging Issues in Water Management for Sustainable Agriculture in South Asia Region, jointly organized by Central Soil and Water Conservation Research and Training Institute, Tamil Nadu, India and Michigan State University, East Lansing, MI, USA, held at CSWCRTI, Ooty, Udagmandalam, 10-12 December 2009.

Valentine Joseph Gandhi B, Bantilan MCS and Parthasarathy D. 2009. Vulnerability Dynamics and HIV Risk in the Semi-Arid Ttropics of Rural Andhra Pradesh. Book Chapter in Vulnerability in Developing Countries (Wim Naude´, Amelia U Santos-Paulino and Mark McGillivray eds.). World Institute for Development Economics Research (UNU-WIDER), FIN-00160, Helsinki, Finland: United Nations University Press. 34 pp.

Anand Babu P and Bantilan MCS. 2008. Addressing Climate Change Vulnerability through Adaptation Strategies and Layers of Resilience. Invited paper for Compendium for Model Training Course on "Impact of Climate Change on Rainfed Agriculture System and Adaptation Strategies", Central Research Institute for the Dryland Agriculture (CRIDA), Hyderabad.

Gandhi BVJ, Bantilan MCS and Parthasarathy D. 2007. Livelihood Risk to HIV Risk in the Semi-Arid Tropics of rural Andhra Pradesh. Paper presented at the UNU – WIDER Conference on Fragile States and Fragile Groups, Helsinki, Finland, 15–16 June 2007.

Padmaja R, Bantilan MCS and Gandhi BVJ. 2004. Gender Dimensions in Social Capital Formation with Implications for Technology Transfer. Paper presented at the FAO Expert Consultation on Gender Dimensions in Asian Rice Livelihood Systems in Changing Milieu of Technologies and Economy, 9–12 March 2004, Bangkok, Thailand. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 37 pp. (Limited distribution.)

Dar WD and Bantilan MCS. 2004. Linking National Professional Associations to International Research Organizations Speech delivered by William Dar, Director General of ICRISAT at the 45th National Convention of the Philippine Agricultural Economics and Development Association, 12 Oct. 2004, Bureau of Soils and Water Management, Quezon City, Philippines.

Dar WD, Bantilan MCS and Padmaja R. 2004. Partner Power in South Asia: Strengthening Agricultural Research and Rural Development Linkages. Discussion paper presented at ADB-ICRISAT workshop on "Strengthening Partnerships for more Effective Planning, Research, and Development in Agriculture", 1-3 September 2004, New Delhi, India

Bantilan MCS and Padmaja R. 2003. Constraints on Agricultural Production in South Asia and Opportunities for International Collaboration. Paper presented at the International symposium organized by JIRCAS for their 10th anniversary celebrations, 18-20 November, Tokyo, Japan.

Bantilan MCS. 2003. AEZs, Productivity, Poverty and Research Targets: Applications for International Agricultural Research Systems. Paper prepared for a workshop on "Green Revolution in Asia and its Transferability to Africa", 15- 16 August 2003, Durban, South Africa.

Bantilan MCS. 2003. Agricultural Research: Priorities in the Global Context. Guest lecture for the 7th Executive Development Programme in Agricultural Research Management. Held at NAARM, Rajendranagar, 22 July 2003.

Bantilan MCS. 2003. Institutional Learning and Change – Lessons from ICRISATs Groundnut Production Technology. Paper presented at ILAC meeting, February 2003. Washington D.C.

Janaiah A and Bantilan MCS. 2003. Has Green Revolution Bypassed Coarse Cereals? The Indian Experience. Paper presented at the workshop on "Green Revolution in Asia and its Transferability to Africa", 15- 16 August 2003, Durban, South Africa.

Parthasarathy Rao P, Hall A and Bantilan MCS. 2003. Dynamics of Cereal Utilization, Market, Trade, and Coalitions: Sorghum and Millets in Asia. Paper presented at the Expert meeting on sorghum utilization, 1-4 July 2003, ICRISAT Patancheru

Bantilan MCS and Anupama GV. 2002. Vulnerability and Adaptation in Dryland Agriculture in India's SAT: Experiences from ICRISAT Village-Level Studies. Paper presented at the Workshop on Adaptation to Climate Change for Agricultural Productivity, organized by Government of India, UNEP and CGIAR, 1-3 May 2002, New Delhi, India.

Bantilan MCS and Anupama KV. 2002. Risk Vulnerability and Coping Mechanisms in Rainfed Agriculture of South Asia: Empirical Evidence.

Paper presented at the ICAR-ICRISAT Workshop on Vision for Rainfed Agriculture in South Asia: Targeting Research for Development, 2-4 Dec. 2002, ICRISAT, Patancheru, India.

Bantilan MCS and Deb UK. 2002. Grey to Green Revolution in India: Role of Public-Private-International Partnership in Research Development. Paper presented at the Asia Regional Conference on Public-Private Sector Partnership for Promoting Rural Development, organized by Bangladesh Agricultural Economists Association and International Association of Agricultural Economists, 2-4 October 2002, Dhaka, Bangladesh.

Bantilan MCS, Rao KPC, Padmaja R, Shiferaw B, Parthasarathy Rao P and Joshi PK. 2002. Rainfed Agriculture in South Asia: Issues paper. Paper presented at the ICAR-ICRISAT Workshop on Vision for Rainfed Agriculture in South Asia: Targeting Research for Development, 2-4 Dec. 2002, ICRISAT, Patancheru, India.

Bantilan MCS and Ryan JG. 2002. Using Impact Assessment in Research Priority Setting: An IARC Experience". Food Policy. Accepted for publication.

Bantilan MCS and Padmaja R. 2002. Accelerating Sustainable Agricultural Growth and Poverty Reduction in the Semi-Arid Tropics: Role of ICRISAT. Paper presented at the Asian Regional Consultation on World Bank's Rural Development Strategy 26-28 Feb. 2002, Hanoi, Vietnam.

Dar WD, Bantilan MCS and Padmaja R. 2002. A Call for Change: Higher Investments in Agricultural Research - An Imperative for Governments and Private Sector. Paper presented at the FAO Ministerial meeting 13-17 May 2002, Nepal.

Joshi PK and Bantilan MCS. 2002. Technology Uptake in Rainfed Areas and its Impacts. Paper presented at the ICAR-ICRISAT Workshop on Vision for Rainfed Agriculture in South Asia: Targeting Research for Development, 2-4 Dec. 2002, ICRISAT, Patancheru, India.

Padmaja R and Bantilan MCS. 2002. Participatory Technology Development and Evaluation – Gender Perspectives from ICRISAT Experiences. Paper presented by R Padmaja at the FAO Expert Consultation meet on "Agricultural Extension, Research-Extension-Farmer Interface and Technology Transfer", July 16-19, Bangkok, Thailand: International Crops Research Institute for the Semi-Arid Tropics.

Shiferaw B, Bantilan MCS and Sirraj R. 2002. Harnessing Improved BNF for the Poor: Assessment of Technological, Policy and Institutional Constraints and Research Needs. Paper presented at the International Workshop on Biological Nitrogen Fixation. 10-14 June 2002, Montpellier, France.

Bantilan MCS, Deb UK and Singh SD. 2000. Farm-level Genetic Diversity in Pearl Millet in India. Poster paper presented at the 3rd International Crop Science Congress, 18-22 Aug. 2000, Hamburg, Germany. August 2000. ICRISAT, Patancheru, India.1 pp.

Bantilan MCS, Parthasarathy D, Padmaja R and Chopde VK. 2000. Agricultural Technologies and Poverty Reduction: Impact Studies from Maharashtra and Rajasthan. Paper presented at the World Bank-organized South Asia Regional Poverty Monitoring and Evaluation workshop, 8-10 Jun. 2000, New Delhi, India. June 2000. ICRISAT, Patancheru, India.

Deb UK, Bantilan MCS and Rai KN. 2000. Impact of Improved Pearl millet Cultivars in India. Paper presented at the NCAP-ICRISAT Workshop on Impacts of Agricultural Research in India, 10-11 Feb. 2000, ICRISAT, Patancheru, India. February 2000. ICRISAT, Patancheru, India.18 pp.

Deb UK, Bantilan MCS and Reddy BVS. 2000. Impact of Improved Sorghum Cultivars in India. Paper presented at the NCAP-ICRISAT Workshop on Impacts of Agricultural Research in India, 10-11 Feb. 2000, ICRISAT, Patancheru, India. February 2000. ICRISAT, Patancheru, India.18 pp.

Deb UK, Mgonja M and Bantilan MCS. 2000. Adoption and Impact Monitoring Systems (AIMS). Paper presented at the ICRISAT-World Vision International workshop on Dissemination of Technologies Enhancing Smallholder Income in Sub-Saharan Africa: Science with a Human Face, 20-23 Nov. 2000, Bulawayo, Zimbabwe. November 2000. ICRISAT, Patancheru, India.

Joshi PK and Bantilan MCS. 2000. Impact of Chickpea Research in Nontraditional Areas. Paper presented at the NCAP-ICRISAT Workshop on Impacts of Agricultural Research in India, 10-11 Feb. 2000, ICRISAT, Patancheru, India. February 2000. ICRISAT, Patancheru, India.

Shiyani RL, Joshi PK and Bantilan MCS. 2000. Assessment of Varietal Preferences of Chickpea in Gujarat. Paper presented at the NCAP-ICRISAT Workshop on Impacts of Agricultural Research in India, 10-

11 Feb. 2000, ICRISAT, Patancheru, India. February 2000. ICRISAT, Patancheru, India.

Bantilan MCS, Parthasarathy D and Padmaja R. 1999. Enhancing Research-Poverty Alleviation Linkages: The ICRISAT Experience. Paper presented at the Conference on Assessing the Impact of Agricultural Research on Poverty Alleviation, 14-16 Sep. 1999, San Jose, Costa Rica. September 1999. ICRISAT, Patancheru, India. 40 pp.

Padmaja R and Bantilan MCS. 1999. Participatory Research and Gender Analysis Approach in Agricultural Technology Evaluation: ICRISAT Experience. Paper presented at the FAO-organized expert consultation on Participatory Methods and Gender Database, 11-14 May 1999, Bangkok, Thailand . 11-14 May 1999. ICRISAT, Patancheru, India.20 pp.

Padmaja R and Bantilan MCS. 1998. Gender differences in Groundnut Production Technology Evaluation and Choice: ICRISAT Experience and Relevance for Future Technology Development. Paper presented at the technical consultation on Gender roles in Peanut Sector for Household Food Security, 9-11 June 1998, Bangkok, Thailand. June 1998. ICRISAT, Patancheru, India. 20 pp.

Bantilan MCS and Joshi PK. 1997. Institutionalization of Research Prioritization, Monitoring and Evaluation (with Joshi PK). Paper presented at the Workshop of "Institutionalizing Agricultural Research Priority Setting, Monitoring and Evaluation", Indian Agricultural Research Institute, 21-22 July 1997, New Delhi.

Bantilan MCS. 1997. Linkages among Measurable Criteria and Sensitivity Analysis for Research Priority Setting: Learning from the Experiences of ICRISAT, 1997. Paper presented at the Workshop of "Institutionalizing Agricultural Research Priority Setting, Monitoring and Evaluation", Indian Agricultural Research Institute, 21-22 July 1997, New Delhi.

Bantilan MCS. 1996. Research Evaluation and Impact Assessment: Status and Its Feedback to Research Process at ICRISAT. 1996. Paper presented at the CGIAR Workshop on Impact Assessment and Evaluation, 15-17 April 1996, The Hague, Netherlands.

Bantilan MCS and Parthasarathy D. 1996. Sustainability Dimension of Adoption of Short Duration Pigeonpeas. 1996. Paper presented in the 40th Conference of the Australian Agricultural and Resource Economics Society, Melbourne, Australia. February, 1996. JA 238.

Bantilan MCS and Ryan JG. 1996. Using Impact Assessment in Research Priority Setting: Developments at ICRISAT. Paper presented at the International Conference on Global Assessment for Science Policy. Melbourne, 26-28 August 1996.

Gowda CLL, Hash CT, Reddy BVS, Stenhouse JW, Singh L and Bantilan MCS. 1996. Collaboration in Plant Breeding Among International and National Agricultural Research Center and the Private Sector: The Case of ICRISAT. Paper presented at the APSA Asian Seed Conference. Jakarta, Indonesia, 25-27 September 1996. CP 1096.

Bantilan MCS, Subba Rao KV and Gowda CLL. 1996. ICRISAT/NARS Joint Impacts: Studies in Asia. Paper presented at the Cereals and Legumes Asian Network Planning Meeting, Bangkok, Thailand, October 1996.

Bantilan MCS and Parthasarathy D. 1996. Efficiency and Sustainability Gains from Adoption of Short Duration Pigeonpeas in Non-legumes based Cropping Systems, paper presented at the 9th Conference of the International Soil Conservation Organization, Bonn, Germany, 26-30 August 1996; also presented as poster paper at the VIII Congress of the European Association of Agricultural Economists, Edinburgh, Scotland, 3-7 September, 1996.

Bantilan MCS and Joshi PK. 1995. Tracking Impact of Wilt Resistance Research in Central India. 1995. Paper presented in the Annual Conference of the Australian Agricultural Economics Society, Perth, February 1995; revised for ICRISAT Impact Series. JA 240.

Bantilan MCS. 1994. Niches of ICPL-87 in Two SAT States of India. (with REIA team). International Chickpea and Pigeon pea Newsletter. ICRISAT, Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Bantilan MCS. 1994. Sensitivity Analysis in Research Priority Setting in a Multi-Objectives Framework. 1994. Paper presented in the 37th Annual Conference of the Australian Agricultural Economics Society, Wellington, New Zealand. JA 239.

Bantilan MCS.1991. Trial-Based Spillover Estimation for Rice, paper presented at the Workshop on "Designing Information Systems to Support Research Priority Assessments in Agricultural Research: Concepts and Practices for International and National Level Institutions, Ming Court Hotel, Kuala Lumpur, Malaysia, May 28-31, 1991.

Bantilan MCS. 1991. Across-Commodity Spillover Effects of Research, SEARCA Professorial Chair. Paper presented at the University of the Philippines at Los Banos, ACCI Auditorium, January 1991.

Bantilan MCS. 1991. Estimating Probability of Research Success: Some Theoretical Considerations. Paper presented at the Experts Consultation and Validation Workshop for Research Priorities in Philippines Agriculture, PCARRD, February 28-March 1, 1991.

Bantilan MCS. 1991. Goal-Setting and Research Prioritization: Conceptual Framework and Application in Philippine Agriculture, Report to PCARRD Organization and Manpower Review, Review and Evaluation Committee Workshop, PCARRD and Crystal Springs, Los Banos, Laguna, 14-15 October 1991.

Bantilan MCS. 1991. Overall Framework for Agricultural Research Evaluation.Paper presented at the Experts Consultation and Validation Workshop for Research Priorities in Philippines Agriculture, PCARRD, February 28-March 1, 1991.

Bantilan MCS and Davis J. 1991. Opportunity Costs in a Multi-Product Production Environment and Across-Commodity Spillover Effects of Research, presented at the 35th Annual Conference of the Australian Agricultural Economics Society, University of New England, Armidale, Australia, February 11-15, 1991.

Bantilan MCS and Davis J. 1991. Research Production Function and Probability of Success in Agricultural Research Evaluation. Paper presented at the 35th Annual Conference of the Australian Agricultural Economics Society, University of New England, Armidale, Australia, February 11-15, 1991

Davis J and Bantilan MCS. 1991. Agricultural Production Response and Cost Structures: Cost Reduction and Output Increasing Linkages for Research Impacts. Paper presented at the 35th Annual Conference of the Australian Agricultural Economics Society, University of New England, Armidale, Australia, February 11-15, 1991.

Bantilan MCS and Rola A. 1990. Pesticide Use and Pesticide Policy in the Philippines. Paper presented at the Workshop on Environmental and Health Impacts of Pesticide Use in Rice Culture, International Rice Research Institute, March 28-30, 1990.

Bantilan MCS, Bernal Dela Rea and Abello. 1990. Poverty and Inequality Measurements: An Application of the Dagum Income Distribution to the

Philippine FIES Data. Paper presented at the 10th Southeast Asia Statistics Seminar, Philippine International Convention Center, Metro Manila, January 10, 1990.

Bantilan MCS, Rola A and Corcolon R. 1990. Farmer's Mortality Statistics in the Philippines: Patterns on Causes of Deaths and Possible Linkages with Chemical Input Use. Paper presented at the Workshop on Environmental and Health Impacts of Pesticide Use in Rice Culture, International Rice Research Institute, March 28-30, 1990.

Bantilan MCS, Rola A and Corcolon R. 1990. Patterns on Causes of Deaths among Farmers in Rice Production Environments in the Philippines. Paper presented at the Annual Conference of the Philippine Agricultural Economics and Development Association, Philippine International Convention Center, October, 1990.

Davis J and Bantilan MCS. 1990. Import Replacement and Export Enhancement as an Objective of Agricultural Research Policy: Interpretation and Measurement. A conference paper presented at the 1990 Annual Conference of the Australian Agricultural Economics Society, Brisbane, Australia, February, 1990.

Bantilan MCS. 1990. Income Distribution and Inequality: A Profile of Poverty in the Philippines, SEARCA Professorial Chair paper presented at the University of the Philippines at Los Banos, ACCI Auditorium, January 17, 1990.

Bantilan MCS and DPRP Research Team. 1990. The Dagum Philippines: Towards a Stronger Methodological Base for Income Distribution and Poverty Policy Analysis. Paper presented at the Seminar Series of the National Statistics Office, NSO Main Conference Hall, December 1990.

Bantilan MCS. 1990. Methodological Considerations for an Effective Utilization of the 1990 Census of Agriculture. Paper presented at the Fifth Annual Convention of the Philippine Statistical Association, Philippine International Convention Center, Metro Manila, January 9, 1990.

Bantilan MCS, Albacea EA and Gironella AIN. 1990. Statistical Properties of Flexible Functional Forms. Paper presented at the SESP/UNDP Research Conference, Philippine International Convention Center, January 9, 1990.

Bantilan MCS. 1989. Alternative Functional Forms with Application to Philippine Rice Production Data. A paper presented at the Symposium on

Quantitative Analysis of Agricultural Development, National Economic Development Authority, NEDA in Makati, August 18, 1989.

Bantilan MCS and Albacea EA. 1989. Agricultural Policy Information Generation System: A Prototype. PSA Research Management Office/ United Nations Development Program.

Bantilan MCS. 1989. Consistency of Data Series: A Mechanism to Effect Full Complementation of Censuses and Surveys. Paper presented at the Department of Agriculture Management Committee Meeting, April 13, 1989.

Bantilan MCS. 1989. Data Elements for the 1990 Philippine Census of Agriculture. Paper presented at the Department of Agriculture Management Committee Meeting, April 13, 1989.

Bantilan MCS. 1989. Life After Monsod, Economic Notes Column, Manila Chronicle, May 1989.

Bantilan MCS. 1989. Mortality Due to Causes Which May be related to Chemical Input Use: Evidence from Eleven Municipalities in the Philippines, 1968-1987.Paper presented at the Meeting on Environmental Impact of Chemical Input Use, International Rice Research Institute, October 31, 1989.

Bantilan MCS. 1989. Production in Philippine Rice Monoculture. A paper presented at the Symposium on Quantitative Analysis of Agricultural Development, National Economic Development Authority, NEDA in Makati, August 18, 1989.

Bantilan MCS. 1989. The Agriculture Statistical System of Generating/ Updating Sampling Frames: A Review. A paper presented to the Management Systems Design and Organization for Agricultural Planning and Policy Analysis Program, Department of Agriculture, January 10, 1989.

Bantilan MCS. 1989. The Censuses of Agriculture as a Basis for Agricultural Sampling Frames. Paper presented to the Management Systems Design and Organization for Agricultural Planning and Policy Analysis Program, Department of Agriculture, January 4, 1989.

Bantilan MCS. 1989. Towards a Harmonized Agricultural Information System, Economic Notes Column, Manila Chronicle, July 31, 1989.

Bantilan MCS. 1988. Rice Farmers' Response to Prices and Environment: Laguna and Central Luzon, Philippines. Paper presented at the Workshop

on Methodologies on Agricultural Policy Analysis, NEDA in Makati, May 20, 1988.

Bantilan MCS. 1988. The State of Agricultural Statistics in the Philippines, Discussion Paper 88-03, Department of Economics Discussion Paper Series, CEM, UPLB, May 1988.

Bantilan MCS. 1987. The Philippine Agricultural Statistical System: Review, Assessment and Recommendations. 1987. USAID/Department of Agriculture.

Bantilan MCS. 1987. Variation in Wages of Hired Farm Labor. Paper presented in the Workshop on Agricultural Policy Analysis, SEARCA, March 23, 1987.

Bantilan MCS. 1987. Shadow Value of Irrigation and Varietal Changes in Rice Farm Production. Paper presented in the Workshop on Agricultural Policy Analysis, SEARCA, March 23, 1987.

Bantilan MCS. 1987. The Annual Econometric Model for Macro-Policy Analysis in the Philippines: A discussion paper presented at the Fourth National Convention on Statistics, DEVSTAT, Philippine Social Science Center, Quezon City, Metro Manila, June 15, 1987.

Bantilan MCS. 1987. Supply and Demand Functions for Rice Farm Agriculture in the Philippines. Paper presented in the Workshop on Agricultural Policy Analysis, SEARCA, March 23, 1987.

Bantilan MCS. 1987. Inconsistent Statistics from Government Firms, Economic Notes Column, Manila Chronicle, September 1987.

Bantilan MCS. 1986. Econometric Issues in Production Analysis, paper presented at the Midterm Meeting for Program on Policy Analysis for Agricultural Development, SEARCA, U. P. at Los Banos, Feb. 5, 1986.

Bantilan MCS. 1986. The Agricultural Producer: Response to Price and Environment. Philippine Institute of Developmental Studies. Metro Manila, Philippines.

Bantilan MCS. 1985. Pest Control: Issues for Public Policy. Agricultural Policy Working Group Workshop Proceedings. Philippine Institute for Development Studies.

Bantilan MCS. 1985. The Problem of Model Selection, paper presented at a Workshop on Methods for Agricultural Policy Analysis, SEARCA, University of the Philippines at Los Banos, College, Laguna, August 13-14, 1985.

Professional Societies

- Member, American Agricultural Economics Association
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- Member, Australian Agricultural and Resource Economics Society
- Member and former Secretary General, Philippine Agricultural Economics and Development Association
- Member of the Board, Philippine Agricultural Economics and Development Association
- Member, Philippine Statistical Association
- Member, International Honor Society of Phi Kappa Phi, University of the Philippines Chapter
- Member, Gamma Sigma Delta Honor Society of Agriculture, North Carolina State University Chapter
- Member, International Honor Society of Economics, Omicron Delta Epsilon, North Carolina State University Chapter

Awards and Reviews

- **Outstanding Researcher**, University of the Philippines at Los Banos, 1990
- **Outstanding Teacher for the Social Sciences**, University of the Philippines at Los Banos, 1991
- Co-winner of ICRISAT's **Doreen Mashler Award** for 2001 (Team effort) for outstanding contribution in pigeonpea research
- Co-winner of ICRISAT's **Doreen Mashler Award** for 2003 (Team effort) for outstanding contribution in chickpea research
- **Resource Mobiliser Award for Asia,** ICRISAT**,** 2009 (Team effort)
- Member of the **External Review Panel** for the McKnight Foundation, 1999
- Member of the **External Review Panel** for the Philippine Council for Agriculture, Resources and Forestry Research and Development, 1991.

Raising the voices of the poor

About the Book

Raising Hope and Nurturing Options for Agricultural Development: Essays in Honor of Cynthia Bantilan is a tribute to an eminent teacher and researcher Dr. Cynthia Bantilan on her 60th birthday by her students, colleagues and mentors. This is an open access e-book that includes two poems and 13 essays. The two poems with well-articulated verses, illustrate her versatile role in life—as a committed teacher, professional researcher and leader, mother and a beloved wife. Essays presented in this volume elaborate on the future of rainfed agriculture, research priority setting and impact assessment for international agricultural research, chickpea revolution, biofuels, management of natural resources, agricultural diversification, gender equity, role of social networks for technology adoption, risks and uncertainties, FDI in retail marketing and regional cooperation for agricultural development.

The volume presents useful insights derived from extensive experience and wisdom, to provide a valuable resource for students, researchers, policy makers, agricultural scientists and others engaged in agricultural development.

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