Sustainable postharvest systems in developing countries — framework for intervention

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Abstract

The historical evolution of postharvest interventions in developing countries over the past 40 years falls into two phases. In the first period (ending in the late 1960s) the emphasis was on central storage systems, and in the second (1970 onwards) on the marketable surplus produced by indigenous people (following the return of their lands). As rural surplus increased, traditional systems broke down, resulting in significant losses. To combat this, the United Nations and other aid agencies expended much effort in a variety of programs. Some successes were achieved, but after 15 years it was realised that there were no straightforward solutions. In most instances, major losses were not in traditional food crops reserved for home consumption, but in new varieties grown for cash. Other complicating factors were agrarian changes and new stresses of social restructuring from urbanisation.

With the expansion in food production now at an end, the concepts of sustainable agriculture are relevant. This paper presents a framework for the development of solutions in postharvest systems based on principles of human needs, agricultural sustainability and limits to environmental impacts.

Introduction

The historical background to the inadequacies of postharvest systems in developing countries have been discussed and attempts at improvement made over several decades. Much of the early work (Hall 1969) was of an exploratory and experimental nature, with efforts concentrated mainly on centralised storage systems and at the interface with rural systems (mainly quality control at purchasing points in rural areas), while later work (De Lima 1975, 1987) gave attention to understanding and improving traditional postharvest practices for rural surpluses.

Thus, while much attention has been given to improving postharvest techniques on small farms, new challenges have been created by expanding agricultural output, agrarian change, social restructuring and various other post-colonial impacts.

Efforts have focused on technical solutions, and while some attempts have been made to examine the traditional social and economic base, little attention has been given to determining the environmental impacts of implementing changes in postharvest systems.

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Relevance of the Principles of Sustainability

Sustainable development, the seeking to 'meet present needs without compromising the ability of future generations to meet their own' (World Commission on Environment and Development 1987), has two key concepts:

- that of human needs (food, clothing, shelter and jobs): and
- that of limitations of the environment (to meet these needs).

Traditional farming systems are essentially ecologically sustainable agricultural systems requiring conservation of energy, diversification of crops and economically viable small production units that process their own production. Industrial development and consequent urbanisation has changed this in many countries.

Human Needs: Social, Biological and Economic

In general, postharvest systems interact with rural and urban sectors of the economy. Therefore attempts to introduce changes to one sector must take into account repercussions in other sectors that will ultimately affect the improvements desired. For example, the introduction of cooperative mills for women in a central African country had unforeseen technical (knowledge base) and social (role and gender) complications. Cereal banks were introduced to absorb some of these repercussions, but the consequences were not thought out, and the final outcome was poor.

Attempts to introduce loss-reduction measures for a particular commodity, e.g. rice, maize or wheat within the rural sector, also require that the responses to these interventions be considered by other sectors of the economy. For example, if pesticides and metal bins are recommended, information must be provided to show that these items are available locally, or that the necessary foreign exchange can be set aside for import of materials. This is often not considered by the 'recommender' with the result that no action is taken after the project ends.

Socioeconomic studies conducted in Asia, Africa and South and Central America indicate that women have a primary role of care in some or all aspects of the postharvest system, particularly through the supply of their labour and that of their children in harvesting operations, in store construction, and in control and safeguard of the stored commodity. Women determine the rate of consumption, pest control activities and other measures to prevent food losses.

Field experience shows that farm-level work cannot be extended in isolation of economic and marketing activities of other agencies (public or private) because there is a two-way interaction between the farm and the market. Farmers often grow traditional varieties for their own consumption. These crops suffer little loss and sell at premium prices on the local market, but the volume of trade represented is small. Many small-scale farmers will grow produce for the external market (Marketing Boards etc.) as a cash crop. It is this crop that will

sustain high losses if adequate postharvest methods are not adopted.

Outcomes from Postharvest Interventions

An overview of the outcomes of projects conducted by a number of agencies over the past 15 years enables broad conclusions to be drawn. These can be summarised as follows.

Benefits of discrete actions

It has become clear through an analysis of outputs of several international agencies that direct interventions are effective only when provided on a short-term basis and for very specific purposes, e.g. small metal silos for cooperative marketing, rodent control in warehouses, pest and commodity management in urban warehouses.

Difficulties of stand-alone projects

The realities of field situations and the complexities of postharvest systems under a variety of agro-ecological conditions have shown that 'stand-alone' postharvest projects at the farm level not directly related to commercial outputs are rarely successful. On the other hand, food conservation projects that are tied in with marketing and sale are more likely to show identifiable benefits.

Catalytic effects

Some activities of international organisations and agencies have been catalytic. A large number of developing countries remain motivated to the prevention of food losses, conservation of their grain stocks and maintenance of foods security. Small projects with well-defined objectives are often more effective than large ones.

Extension package of improvements

While many technologies exist or can be adapted to local needs, problems arise in implementation. When putting together an extension package several questions need to be answered.

- What are the improvements? Are they sustainable?
- Are they acceptable? To whom? To whom are they not acceptable?
- Can they be tested? What are the test criteria?
- Are they marketable?
- What knowledge base do they assume?
- What is the level of training required?
- Who should be trained and how?

Marketplace adoption

The marketplace does provide some measure of the value of a technology and there are numerous examples. It may be market influenced, as for example when a marketing agency or trader demands a certain standard of product. In other cases it is an innovation that has come at the right time e.g. a new milling technology, a bulk storage container, a disinfestation technique, or a drying or curing technique.

Lack of local environmental capacity

Many projects are conducted without consideration of the capacity of the local environment to absorb them. An example of this is a longterm regional project in Western Africa where improved grain drying techniques were developed requiring firewood to dry maize on the cob. The recommendations were not adopted because it was found to be an inefficient practice and twice as expensive as other means of drying grain; besides, there was a shortage of firewood and this created new environmental impacts.

Successful interventions

The real wisdom to be gained from past interventions is that they are most likely to succeed if taken up as part of long-term development programs connected with farming systems, food security, primary processing, marketing and investment.

A structured approach

A distinction should be made between a government–donor 'wish list' and what is, in reality, possible given the attitudes of the target groups and the limits of money and expertise. To examine this in a more structured way an analytical framework is proposed.

Environmental Limits: an Analytical Framework

In general, postharvest project interventions should be appraised within policy imperatives. A mass of information is generally available. This often confounds the issues. Therefore, an analytical framework is proposed to logically aggregate this information.

Four aspects require attention: the 'sociopolitical' culture, the economic and market alternatives, the biological attributes and the environmental impacts. At the outset the social structure at the lowest level of intervention must be understood and characterised.

Sociopolitical culture

Major considerations relate to the:

- national policymaking process
- structure of the decision-making process
- consultative process at all levels
- participative process at all levels
- project relevance and interest at all levels
- knowledge and skills base of the target groups
- process for action, participation and accountability at the project (intervention) level.

Economic and market alternatives

At national and local levels these relate to:

- food security
- forecasts of demand
- location and availability of alternative supplies
- pricing options
- measures of food conservation
- marketing of food stocks

Biological attributes

At the ecosystem level these affect:

- existing farming systems and subsystems
- pre and postharvest systems
- energy requirements and availability

- food quality and nutrition
- pesticides and non-target organisms

Environmental impacts

These must be assessed on:

- capacity of the local environment to absorb loss reduction measures
- economic resources
- health related risks
- damaging side-effects

The cross-connections and dependencies of these aspects are illustrated in Table 1. The matrix has two axes. The primary axis contains the matrix elements where basic concepts of the social and environmental setting are considered; and quantitative evaluation is developed; areas of uncertainty recognised; the level and scope of the intervention is set; and a feedback and audit process is established. The secondary axis separates the development of postharvest projects into three stages: policy, form and structure of the initiative; the project development and its consultative process; and extension and communication of outputs.

This matrix and the analytical framework it contains is an attempt to crystallise the thinking process in the formulation and conduct of postharvest projects and to assess their impacts for environmental sustainability. These concepts are not elaborated as the precise nature of each element (and its subset) will be determined by local conditions.

Conduct of the work program cycle

The work program begins with a 'desk phase' which involves a 'gelling' of the basic concepts and methods of quantitative evaluation. This is followed by a 'field phase' in which the level and scope of intervention is determined through rapid statistically designed socioeconomic and biological surveys (De Lima 1992) and scoping meetings with affected groups. Finally, there is an intermediate desk/field phase with development of feedback and audit. This cycle should be used iteratively throughout the project. The advantage of this approach is that it gives both the target groups and project management more control over outputs, and enables aid agencies to decide fairly rapidly the manner in which project investment should proceed.

Conclusions for the Future

Loss reduction and the development of adequate postharvest interventions are strongly linked with political, economic, social and environmental factors. In trying to develop and extend better postharvest techniques, many agencies often encounter complexities of rural and urban situations far beyond the capabilities of projects designed to solve them.

A major weakness in the design of some postharvest projects is that they do not lead quickly enough to loss-reduction strategies; and one of the key reasons for this is that there is an inadequate prediction and analysis of likely outcomes and areas of uncertainty, before initiation of field projects. Projects therefore conclude with a list of loss-reduction measures, which are added to the recommendations.

To remedy this failing, a framework of operation is proposed in the development of sustainable postharvest projects. This examines the basic concepts affecting postharvest systems and the processes by which improvements can be made. Inherent in this framework design is the emphasis on planning, evaluation, scoping, defining areas of uncertainty and establishing feedback and audit mechanisms to determine if the interventions are proceeding in the right direction and the extent to which corrections must be made.

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Table 1. A framework for project intervention in sustainable postharvest systems

Matrix elements	Stages in the development of postharvest project interventions		
	Policy formulation and structural form of the postharvest initiative	Project development through consultative processes	Extension and communication
Basic concepts	–Sociopolitical –Economic –Biological –Environmental	Develop goals, objectives, outcomes and achievements sub-matrices.	Identify target groups and confirm the relevance of initiatives. Modify as required.
Quantitative evaluation	Identify quantitative criteria to measure performance for each goal, objective and outcome.	Establish a preliminary list of performance indicators for each. Determine areas of uncertainty.	Communicate list at policy and project levels. Discuss areas of uncertainty in project outcomes.
Level and scope of interventions	Set time and space boundaries for scoping of decisions. Limit areas of uncertainty.	Set boundaries to social, political, economic, biological and environmental criteria.	Apply interventions that receive approval. Communicate results to all concerned.
Feedback and audit	Develop transparent activity-based feedback that is capable of quantitative evaluation and audit.	Establish criteria and measures to facilitate feedback and audit.	Examine impacts and modify interventions as required through the evaluation and audit process.