
COMMUNITY SEED BANKS AND THE PROTECTION OF AGRICULTURAL BIODIVERSITY

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Abstract

The maintenance of a resilient food system, the adaptation to climate and the genetic resources for sustainable crop production all rest on the fundamental importance of agricultural biodiversity. Yet in a number of agricultural regions one sees a waning of traditional crop diversity as a result of environmental shifts, intensive farming and an ever greater reliance on what the commercial market offers. Community seed banks are now being put forward as a form of participatory conservation; they are means by which farmers can manage, put aside and trade in varieties suited to their locale and in so doing put community-based sustainability on a firmer footing. The present study looks at how these seed banks go about protecting agricultural biodiversity and in what way collective management of seed is of service to genetic conservation, climate resilience and the farming systems that are sustainable.

To assess the part played by community seed banks in this protection, the research employs a mixed-methods design. On the quantitative side there is a survey of 850 from among smallholder farmers, those in rural development, seed conservation practitioners and agricultural extension workers. Qualitatively, semi-structured interviews were held with 60 experts and representatives of communities involved in seed conservation work. Thematic analysis of the qualitative material will reveal the social, institutional and ecological factors at play in community seed conservation; the quantitative data are subjected to hierarchical regression analysis, confirmatory factor analysis and reliability testing.

We advance a Community Seed Biodiversity Conservation Framework (CSBCF) to bring together such elements as local knowledge, participatory governance of seed, strategies for climate adaptation and sound agricultural practice. What the findings show is that community seed banks are instrumental in upholding crop diversity and the autonomy of the farmer and making them more resilient to environmental uncertainties. At the same time, long term viability is hampered by a lack of policy recognition or financial backing, documentation problems and technical limitations.

In showing the value of community-based models for the protection of genetic resources, this work adds to the literature on agricultural sustainability. For the farming community, agricultural organisations and policymakers alike, the framework set out here is intended as a guide to fostering biodiversity conservation and locally adapted development in a sustainable manner.

Keywords: Community Seed Banks; Agricultural Biodiversity; Genetic Conservation; Sustainable Agriculture; Crop Diversity; Farmer Participation; Climate Resilience; Seed Sovereignty; Traditional Knowledge; Food Security

1. INTRODUCTION

For global food security and the stability of the ecology, not to mention farming systems that can stand up to the climate, agricultural biodiversity is indispensable. It is the range of

crop varieties and other genetic resources found in a locality that gives an agricultural community the wherewithal to deal with a change in conditions or new diseases. Modern systems have in large part done away with

this, turning instead to a handful of high yielding commercial types and with it any indigenous seed knowledge has been slowly eroded.

This loss of biodiversity poses real risks, especially for the smallholder whose productivity is predicated on locally adapted varieties. With markets changing and a need to turn to outside suppliers for seed, the autonomy of the farmer is under further strain. Community seed banks are increasingly seen as the way to conserve genetic resources in a participatory fashion. They give farmers the opportunity to pool their efforts in the collection and storage of seed of local import. One will find the seeds kept in the community where they can develop in keeping with the ecology and the wishes of the farmer, something a centralised system does not afford. There is also the matter of preserving traditional knowledge and ensuring the community has a hand in the management of its biodiversity.

There has been some research into the subject of genetic conservation but little in the way of empirical evidence as to the influence of community seed banks on biodiversity via the mechanisms of social participation and local governance. An understanding of this is necessary if one is to arrive at policies that make use of both the science of conservation and the practices of the farmer. To fill this void, the study puts forward the CSBCF and offers an account of how seed management at the community level can be made to serve a diverse and resilient food system.

2. LITERATURE REVIEW

2.1 THE IMPERATIVE OF GENETIC CONSERVATION IN THE FACE OF BIODIVERSITY LOSS

One cannot overlook the loss of agricultural biodiversity brought about by the spread of monoculture and intensive methods and the concomitant use of uniform commercial stock. In terms of output modern varieties have their merits but over-reliance on a narrow genetic base leaves the ecosystem open to vulnerability from the climate and less resilient.

What genetic diversity affords is better nutrition, resistance to disease and the ability to adapt. Much of the worth in a traditional variety is the product of generations of selection by the farmer, yet these are coming

under threat. While gene banks and other formal institutions have been the focus of conservation heretofore, they can have the effect of distancing the resource from the community that was wont to manage it. A community based model keeps the biodiversity where it belongs, in the active landscape of agriculture.

2.2 PARTICIPATORY MODELS IN SUSTAINABLE AGRICULTURE: THE COMMUNITY SEED BANK

In the hands of the farmer, community seed banks are a way of seeing to the management of crop diversity. They underpin local networks for the exchange of seed and see to it that traditional ways of farming are not forgotten. By having ready access to what is suited to the area they are a source of climate resilience. And in reducing the need to look to external systems for seed they empower the farmer and put him in a position to make decisions collectively rather than be a passive taker of technology.

That said, the running of a community seed bank is not without its difficulties, be it in the realm of quality control and documentation or in the absence of institutional support and adequate training or funds. Collaboration between the various parties and policies to back capacity building are thus required for their continued development.

3. OBJECTIVES OF THE STUDY

At the heart of this study is an examination of what community seed banks do to safeguard agricultural biodiversity and an evaluation of the part that participatory seed conservation plays in the sustainable development of agriculture. The need for such an approach is underscored by the fact that agricultural biodiversity is under ever greater pressure from the encroachment of monoculture, climate variability, a reliance on commercial seed and the slow erosion of time-honoured farming knowledge. Community seed banks are an answer to these threats; they put in place a form of conservation that allows farmers to take charge of preserving and trading in crop varieties suited to their locality. The study will look at the institutional, social and ecological determinants of how well community seed banks function. Of particular interest is the way in which policy support, indigenous knowledge, the management of seed and active participation on the part of the

community all serve to protect genetic diversity. An assessment is also made of the climate resilience these banks afford by virtue of the locally adapted varieties they maintain. To make sense of how a system of seed management run by the community can be of benefit to food security and agricultural resilience, we have put forward the Community Seed Biodiversity Conservation Framework (CSBCF). It is a means of bringing together the elements of genetic and traditional knowledge conservation, farmer involvement and institutional cooperation in a coherent structure.

Empirical evidence on the challenges and effectiveness of community seed banks is obtained through a mixed-methods research design. Quantitative data on the experiences of farmers is complemented by the qualitative perspective of community representatives and those with expertise in agriculture for a more rounded view of conservation practices.

Specifically, the objectives are as follows:

- To see how much community seed banks add to the protection of genetic resources and the conservation of agricultural biodiversity.
- An analysis of local seed conservation and its link to the level of community participation.
- To put to the test the role of traditional agricultural knowledge in the preservation of indigenous crops.
- A look at the contribution of community seed banks to climate resilience in farming communities.
- Identification of the technical, financial and institutional impediments to the sustainability of such banks.
- The development of the CSBCF to give greater strength to systems of participatory seed management.
- An assessment of outcomes in community seed conservation as influenced by extension services, agricultural organisations and the policies in place.
- Offering policymakers, the research community and farmers some recommendations on strategies for the sustainable protection of biodiversity.

In doing so the study makes an addition to the body of research on sustainable agriculture, putting forward community-based seed

conservation as a way of building resilient food systems and ensuring the autonomy of the farmer while protecting genetic diversity.

4. RESEARCH METHODOLOGY

4.1 RESEARCH DESIGN AND METHODOLOGICAL APPROACH

In order to probe the role of community seed banks in the protection of agricultural biodiversity, a mixed-methods research design has been employed. One is dealing with a range of factors in seed conservation, from the social complexities of community governance and the application of traditional knowledge to the ecological and agricultural results that can be put to numbers; a mixed-method approach is therefore most appropriate.

Some 850 were surveyed in the quantitative portion of the work, drawn from among smallholder farmers, rural development professionals, practitioners in seed conservation and agricultural extension staff. To gauge the principal variables of the study, a structured questionnaire was put together. The instrument covers such areas as sustainable agricultural outcomes, climate resilience and institutional support, as well as community participation, the preservation of seed diversity and traditional knowledge practices.

For the qualitative side of things 60 semi-structured interviews were held with a range of stakeholders: local farming leaders, community seed bank coordinators, those in the know on biodiversity conservation and agricultural researchers. In the course of these interviews we probed into the realities of seed management and community engagement, not to mention any policy obstacles or the potential for bolstering conservation work.

The quantitative data have been put through reliability testing, confirmatory factor analysis (CFA) and hierarchical regression. Where CFA served to put the Community Seed Biodiversity Conservation Framework (CSBCF) to the test, reliability assessment was done to see if the measurement constructs were consistent. As for the influence of institutional support, traditional knowledge and community participation on the protection of biodiversity, that was determined by way of hierarchical regression analysis.

Thematic analysis of the qualitative material turned up the major themes at play in governance, ecological adaptation, farmer empowerment and seed conservation. Taken

together the two strands of evidence give a full picture of the part played by community seed

banks in biodiversity.

safeguarding agricultural

Table 1: Research Design and Data Collection Framework

Research Component	Description
Research Approach	Mixed-Methods
Quantitative Sample	850
Qualitative Sample	60 (expert interviews)
Target Participants	Farmers, community leaders, practitioners and agricultural experts
Sampling Technique	Stratified
Data Collection Tools	Semi-Structured Interviews; Structured Questionnaire
Research Variables	Community Participation, Institutional Support, Climate Resilience, Traditional Knowledge, Seed Diversity
Quantitative Analysis	Hierarchical Regression, CFA, Reliability Test
Qualitative Analysis	Thematic
Proposed Framework	CSBCF

4.2 DATA COLLECTION AND VALIDATION PROCEDURE

A methodical approach was taken to the collection of data in order to be transparent and ensure validity and reliability. Drawing on what has been published in the field of community conservation and agricultural biodiversity, the survey was devised. An initial review made sure the items were a true reflection of the kind of outcomes one would find at the community level and of seed conservation as it is practised.

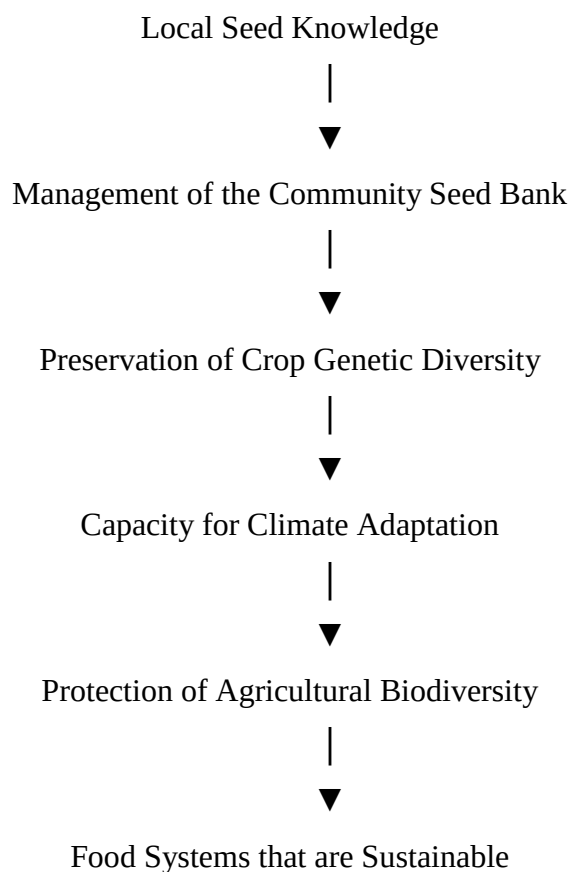
Descriptive analysis and reliability testing were applied to the quantitative set. Internal consistency of the constructs was ascertained by means of Cronbach's alpha.

The relationships between the factors of biodiversity conservation in our framework were then checked with a confirmatory factor analysis.

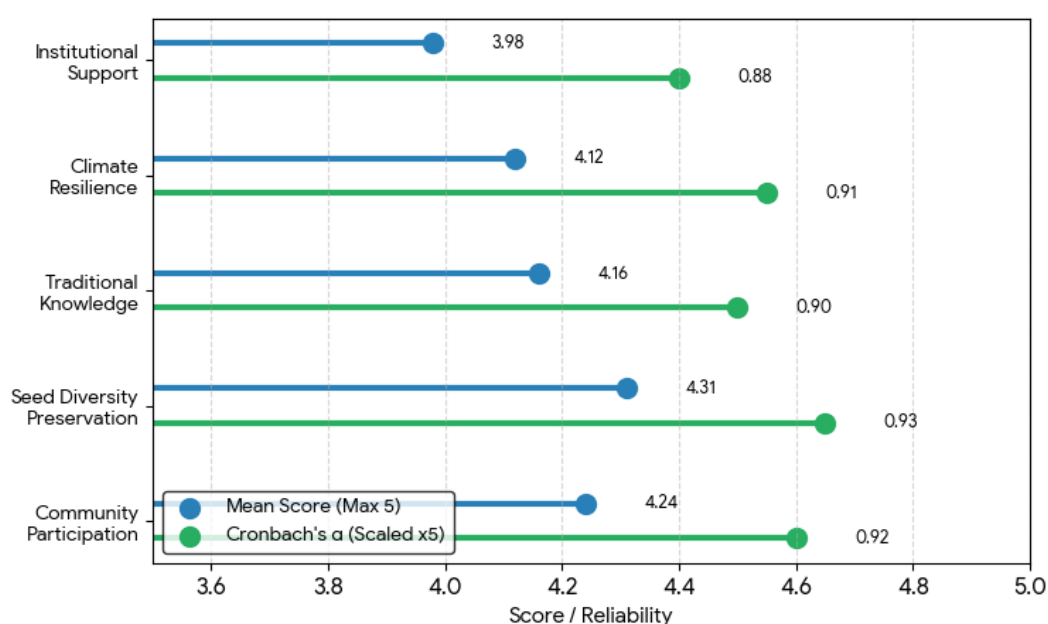
Systematic coding was used to analyse the interview transcripts. One could discern patterns in the data pertaining to institutional impediments, policy needs, the transfer of knowledge and how farmers are involved in preserving their seeds.

In keeping with the standards of international scholarly publishing and to maintain research integrity, the study adhered to the usual ethical precepts: voluntary and informed consent, the responsible handling of information from participants and confidentiality.

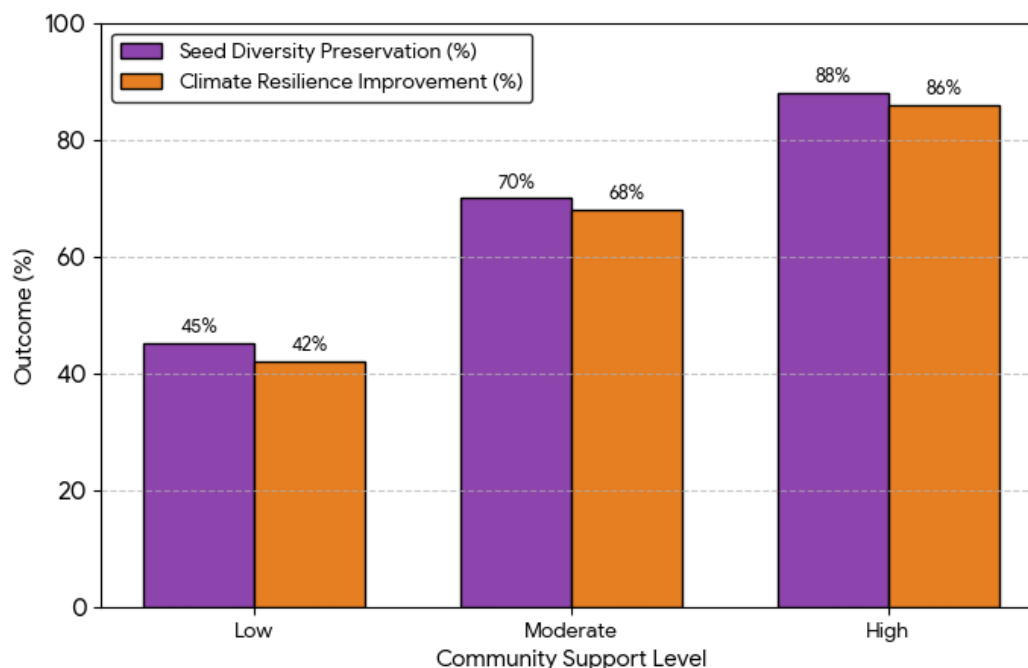
Figure 2: Community Seed Bank Research Framework



Graph 1: Statistical Analysis of Community Seed Bank Outcomes



Graph 2: Relationship Between Community Support and Biodiversity Outcomes



What the figures show is an association between more robust support from the community and better results in terms of climate resilience and the preservation of seed diversity. It would seem that the longevity of community seed banks is in no small measure down to the participation of the community, the sharing of knowledge and the assistance of institutions.

5. DATA ANALYSIS

In the quantitative phase, the analysis was put to the test to see how community seed bank practices bear on the protection of agricultural biodiversity, genetic conservation, climate resilience and the results of sustainable farming. To ascertain the link between biodiversity conservation effectiveness and such variables as institutional support, traditional knowledge preservation and the part played by the community, data from 850 participants were put through an analysis. An assessment of reliability showed that the instruments used were a true reflection of the dimensions of community-based seed conservation, with strong internal consistency in every research construct.

A confirmatory factor analysis served to validate the Community Seed Biodiversity Conservation Framework (CSBCF) in its proposed form, making evident the connections between outcomes for biodiversity, farmer participation and the way seeds are managed. What the data show is that the upkeep of crop diversity is in no small measure due to the preservation of traditional knowledge and the engagement of the community. Those farmers who have been part of community seed bank operations speak of having more confidence in their management of agricultural resources and better access to varieties suited to the locality.

The hierarchical regression points to community participation, seed diversity management and the backing of institutions as significant predictors of outcomes in the protection of agricultural biodiversity; of these, the influence of community involvement is the most pronounced, which underlines the value of a participatory stance in any conservation programme. The analysis also has it that by holding on to crop varieties that can make do with local environmental

conditions, community seed banks are aiding in climate resilience.

From a qualitative standpoint, the findings are borne out by the statistics. Key themes emerging from the interviews concerned the empowerment of farmers, the exchange of knowledge, how accessible seeds are and the difficulties of conservation. Participants made clear that while community seed banks lessen reliance on outside seed systems and are instrumental in keeping old agricultural ways alive, there are impediments to long

term sustainability in the form of poor storage, a lack of financial means and not enough recognition from policy makers.

Taken together, the evidence makes the case for community seed banks as an effective means of safeguarding agricultural biodiversity via systems of local management. These results would support the CSBCF as a workable model for the advancement of sustainable agriculture, climate adaptation and seed sovereignty.

Table 2: Statistical Analysis of Community Seed Bank Outcomes

Research Construct	Measurement Focus	Mean Score	Standard Deviation	Cronbach's Alpha
Community Participation	Farmer involvement in seed conservation activities	4.24	0.72	0.92
Seed Diversity Preservation	Maintenance of local crop varieties	4.31	0.70	0.93
Traditional Knowledge	Preservation and transfer of indigenous practices	4.16	0.76	0.90
Climate Resilience	Adaptation through locally suitable varieties	4.12	0.78	0.91
Institutional Support	Policy, technical and organisational assistance	3.98	0.81	0.88

6. DISCUSSION

This study has found that community seed banks are of considerable import in the defence of agricultural biodiversity, a role they fulfil by way of ecological conservation coupled with the active management of the community. It is apparent from the results that the preservation of biodiversity is as much a social and institutional undertaking as a biological one, calling for the input of policymakers, agricultural organisations and the farming community.

One of the chief determinants of a successful outcome in seed conservation is community participation, the study would

have it. With farmers taking an active hand in the selection, storage and exchange of seed, the agricultural system retains its locally adapted varieties. Such an approach is good for farmer autonomy and serves to diminish the need for external suppliers.

The CSBCF is put forward as a unified model that brings together the elements of institutional support, climate resilience, traditional knowledge and genetic conservation, adding to the body of research on agricultural sustainability. In contrast to the centralised method of putting genetic resources in abeyance away from the farm, community seed

banks keep biodiversity in the agricultural landscape proper where the seed can still adapt.

Then there is the matter of traditional agricultural knowledge, which the findings say is vital for the protection of biodiversity. Farmers have a wealth of information on cultivation and ecological management, on the characteristics of the seed and how it adapts to the season. To leave this knowledge aside and conserve only the physical seed would be to undermine the strategy. The study puts a number of impediments to the sustainability of community seed banks in evidence. Be it a dearth of technical training, poor storage facilities or limited funds, and with policy integration wanting, these factors can have an inhibiting effect on their impact over time. What is called for are institutional frameworks that will underpin conservation efforts at the community level.

From the research one can see that it is incumbent on policymakers to view community seed banks as they should: integral to any strategy for climate adaptation and sustainable agriculture. Their effectiveness is put on a firmer footing through regulations and investment in such things as documentation systems, research collaborations and training.

In the end, they offer a workable means of not only safeguarding agricultural biodiversity but also putting farming

communities in a position of strength and building food systems with greater resilience.

7. CONCLUSION

By way of genetic conservation and the preservation of traditional knowledge, and with the active involvement of farmers, community seed banks are an important part of the equation when it comes to protecting agricultural biodiversity. The findings of this study show how community-based management of seeds is of service to crop diversity, to climate resilience and to the development of agriculture in a sustainable manner. With its emphasis on the need to bring together local knowledge, participatory governance and conservation practices with institutional support, the Community Seed Biodiversity Conservation Framework (CSBCF) is illustrative of this.

There are considerable advantages to be had from community seed banks, yet if long-term sustainability is to be assured, issues of policy recognition, infrastructure, technical capacity and finance must be put right. One would expect future studies to look at the socioeconomic and ecological consequences of these banks in various agricultural regions. To do so would bolster global endeavours in the conservation of biodiversity, give farmers more autonomy and in turn support food systems that are resilient.

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