Evidences

Study #4340

Contributing Projects: <Not Defined>

Part I: Public communications

Type: OICR: Outcome Impact Case Report

Status: Completed

Year: 2021

Title: Farmer Engagement in Citizen Science for Varietal Diversification Enhanced Adaptive Capacity and Productivity of 25,000 Farmers in India

Short outcome/impact statement:
The Seeds for Needs (S4N) initiative has involved over 25,000 farmers as citizen scientists in India, generating positive effects on the level of on-farm varietal diversification, both for rice (+5.,15%) and wheat (+10,.87%). A more diversified production has in turn positively influenced the perceived changes in the yield of the two crops (i.e., +3,.94% rice and 4.,80% wheat). Improved yield trends have enhanced households' overall capacity to recover from agricultural shocks (+7.,46%).

Outcome story for communications use:
With climate patterns increasingly severe and unpredictable, farmers need strategies to hep them manage risk and adapt to different climatic conditions. The Seeds for Needs project in India, gave resource-poor farmers access to a wide portfolio of different crops and crop varieties that they could choose between to minimize their risks and adapt to different climate conditions. Farmers were included in the participatory trials as 'citizen scientists' asked to plant a small selection of seeds, then rate them according to their own needs.
Seeds for Needs initiative started in Bihar in 2010 and now involves over 25,000 farmers in nine states in India. An impact assessment carried out at the end of the project found that households who had been involved in the project had much higher levels of crop diversity in their staple crops (+5% for rice and +11% for wheat). The study also found that these households benefitted from a perceived increase in yield (+3.94% for rice and +4.80% for wheat). Lastly, participation as citizen scientists has generated an increase in their ability to recover from shocks.
Seeds for Needs (S4N) is the largest citizen science-based intervention to date, involving 25,000 farmers and 47,000 plotsseasons in India. The impact study tested the hypothesis underlying the S4N initiative. Access to crop varietal diversity through crowdsourced citizen science overcomes the lack of capital and knowledge of Indian farmers and provides a unique opportunity for them to evaluate and identify varieties that better adapt to the local context. This, in turn, stimulates farmers to adopt varietal diversification as a livelihood strategy. They then use these varieties to boost yields and improve households' recovery ability.
The project outcomes highlight the effectiveness of development programmes aimed at strengthening rural livelihoods through participatory approaches and use of local crop varietal diversity. S4N contributed to agricultural practices that not only strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters (SDG2.4) but also maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels (SDG2.5).

Links to any communications materials relating to this outcome:

- https://cgspace.cgiar.org/handle/10568/69162
- https://www.bioversityinternational.org/seeds-for-needs/
- https://tinyurl.com/yxlt9j57
- https://cgspace.cgiar.org/handle/10568/101575

Part II: CGIAR system level reporting

Link to Common Results Reporting Indicator of Policies : No

Stage of maturity of change reported: Stage 3

Links to the Strategic Results Framework:
Sub-IDOs:

- Increased household capacity to cope with shocks
- Increased livelihood opportunities

Is this OICR linked to some SRF 2022/2030 target?: Yes

SRF 2022/2030 targets:

- Increased rate of yield for major food staples from current 1%/year
- # of more farm households have adopted improved varieties, breeds or trees

Description of activity / study: <Not Defined>

Geographic scope:

- National

Country(ies):

- India

Comments: <Not Defined>

Key Contributors:

Contributing CRPs/Platforms:

- CCAFS - Climate Change, Agriculture and Food Security

Contributing Flagships:

- FP2: Climate-Smart Technologies and Practices

Contributing Regional programs: <Not Defined>

Contributing external partners:

- ICAR - Indian Council of Agricultural Research

CGIAR innovation(s) or findings that have resulted in this outcome or impact:

Seeds for Needs (S4N) is the largest citizen science-based intervention to date, involving 25,000 farmers and 47,000 plotsseasons in India (1; 2; 3). S4N initiative started in the 2010 and has been implemented with the aim of promoting and using the diversity of plant genetic resources as a means to reduce farmers' vulnerability to climate change (4; 11). The current impact study (6) examines if an increase in the varietal diversity of major staple crops, namely wheat and rice under real farming conditions contributed to: (a) crop productivity and (b) the ability of households to recover from agricultural production shocks. The hypothesis underlying the study is that access to crop varietal diversity through crowdsourced citizen science overcomes the lack of capital and knowledge of Indian farmers and provides a unique opportunity for them to evaluate and identify varieties that better adapt to the local context (1). This, in turn, stimulates farmers to adopt varietal diversification as a livelihood strategy. They will then use these varieties to boost yields and improve households' recovery ability. The results of the impact assessment study (6) confirm that farmer engagement as citizen scientists positively affects the level of on-farm diversification, both for rice and wheat. A more diversified production system has in turn positively influenced the perceived changes in the yield of the two crops. Improved yield trends have enhanced households' overall capacity to recover from agricultural shocks (5; 6; 7). Outcomes highlight the effectiveness of development programmes aimed at strengthening rural livelihoods through participatory approaches and use of local crop varietal diversity.

Innovations: <Not Defined>

Elaboration of Outcome/Impact Statement:

The S4N initiative took place in Bihar, India from 2010 to 2017. The data used for the impact assessment (6) are generated from a household questionnaire administered in 2018 on a sample of 600 stratified, randomly selected rural households (300 households exposed to the S4N initiative and 300 households not exposed) of three districts of Bihar: Saran, Samastipur, and Vaishali (8). Two empirical analyses were carried out:

a. The first analysis relies on the Doubly Robust estimator to quantify if any substantial differences between households participating in the initiative, compared to those that have not been involved, can be effectively attributed to the S4N initiative (9). The Doubly Robust estimator combines two different approaches to estimate the causal effect of an exposure on the outcome: a specification for the outcome regression and a specification for the exposure. This ensures the robustness of the results because possible forms of misspecification of the model due to selection bias and confounding effects are both considered (8). Empirical results indicated that exposure to initiative activities generated positive and significant changes on the variety portfolio of smallholder farmers. The Simpson's Diversity Index of exposed households was higher than that of non-exposed households (+5% for rice and +11% for wheat). The Doubly Robust results also confirm that exposed households benefitted from a perceived increase in yield (+3.94% for rice and +4.80% for wheat). Lastly, participation as citizen scientists has generated an increase in their ability to recover from shocks of around 7% of the actual mean value.

b. The second analysis consists in a simultaneous system of equations to assess the consequentiality of the steps linking the livelihood benefits (highlighted by the first analysis) to participation in the S4N initiative. Results provide evidence that: (a) the adoption of the varieties disseminated through S4N positively affected varietal diversity of rice and wheat; (b) a more diversified production has in turn positively influenced the perceived changes of the yield of the two crops; and lastly, (c) the improved wheat yield trends have enhanced overall recovery capacity of the households from agricultural shocks.

The outcomes of the empirical analysis highlight the effectiveness of development programmes aimed at strengthening rural livelihoods through participatory approaches and use of local agrobiodiversity (5; 10; 11). Furthermore, the methodology implemented in the study (6) allows us to make inferences on the 25,000 farmers involved in the S4N initiative as citizen scientists.

References cited:
•[1] Pagnani, T., Gotor, E., & Caracciolo, F. (2021). Adaptive strategies enhance smallholders' livelihood resilience in Bihar, India. Food Security, 13(2), 419-437 (https://doi.org/10.1007/s12571-020-01110-2)
•[2] van Etten, J. (2011). Crowdsourcing crop improvement in sub-Saharan Africa: a proposal for a scalable and inclusive approach to food security. IDS bulletin, 42(4), 102-110. (https://doi.org/10.1111/j.1759-5436.2011.00240.x)
•[3] van Etten, J., de Sousa, K., Aguilar, A., Barrios, M., Coto, A., Dell'Acqua, M., ... & Steinke, J. (2019). Crop variety management for climate adaptation supported by citizen science. Proceedings of the National Academy of Sciences, 116(10), 4194-4199. (https://doi.org/10.1073/pnas.1813720116)
•[4] Gotor, E., Pagnani, T., Paliwal, A., Scafetti, F., Van Etten, J., & Caracciolo, F. (2021). Smallholder farmer engagement in citizen science for varietal diversification enhances adaptive capacity and productivity in Bihar, India. Frontiers in Sustainable Food Systems, 5:726725 (https://doi.org/10.3389/fsufs.2021.726725)
•[5] Seeds for Needs: crop diversity for resilience. Bioversity Factsheet (https://cgspace.cgiar.org/handle/10568/101575)
•[6] Gotor, E., Scafetti, F., Pagnani, T., Paliwal, A., & Caracciolo, F. (2018). Impact assessment of the Seeds for Needs Initiative in India: A Case Study of Bihar (https://cgspace.cgiar.org/handle/10568/100155)
•[7] van Etten, J., Beza, E., Calderer, L., Van Duijvendijk, K., Fadda, C., Fantahun, B., ... & Zimmerer, K. S. (2019). First experiences with a novel farmer citizen science approach: crowdsourcing participatory variety selection through on-farm triadic comparisons of technologies (tricot). Experimental Agriculture, 55(S1), 275-296. (https://doi.org/10.1017/S0014479716000739)
•[8] Gotor, E.; Scafetti, F.; Paliwal, A.; van Etten, J.; van Wijk, M.; Hammond, J.; Caracciolo, F., 2018, "Seeds for Needs India Impact Assessment", https://doi.org/10.7910/DVN/DW2W9J, Harvard Dataverse, V2, UNF:6:OJ/vPkYHJ8DlupYLrN/gNw== [fileUNF] (https://doi.org/10.7910/DVN/DW2W9J)
•[9] Fadda, C., Mengistu, D. K., Kidane, Y. G., Dell'Acqua, M., Pè, M. E., & Van Etten, J. (2020). Integrating conventional and participatory crop improvement for smallholder agriculture using the Seeds for Needs Approach: a review. Frontiers in Plant Science, 11 (https://doi.org/10.3389/fpls.2020.559515)

Quantification:

Type of quantification: a) Actual counts or estimates from a particular study (please provide reference)
Number: 5.00
Unit: %
Comments: Number box: 4.80 Unit box: percent Comment: p-value: 0.016; The Doubly Robust estimator indicates that the Perceived Change of Yield for wheat of exposed households was 4.80percent higher than that of non-exposed households. Reference (6).

Type of quantification: a) Actual counts or estimates from a particular study (please provide reference)
Number: 11.00
Unit: %
Comments: Number box: 10.87 Unit box: percent Comment: p-value: 0.000; The Doubly Robust estimator indicates that the Simpson's Diversity Index for wheat of exposed households was 10.87percent higher than that of non-exposed households. Reference (6).

Type of quantification: a) Actual counts or estimates from a particular study (please provide reference)
Number: 4.00
Unit: %
Comments: Number box: 3.94 Unit box: percent Comment: p-value: 0.053; The Doubly Robust estimator indicates that the Perceived Change of Yield for rice of exposed households was 3.94percent higher than that of non-exposed households. Reference (6).

Type of quantification: a) Actual counts or estimates from a particular study (please provide reference)
Number: 7.00
Unit: %
Comments: Number box: 7.46 Unit box: percent Comment: p-value: 0.001; The Doubly Robust estimator indicates that the Recovery capacity from agricultural shocks of exposed households was 7.46percent higher than that of non-exposed households. Reference (6).

Type of quantification: a) Actual counts or estimates from a particular study (please provide reference)
Number: 5.00
Unit: %
Comments: Number box: 5.15 Unit box: percent Comment: p-value: 0.042; The Doubly Robust estimator indicates that the Simpson's Diversity Index for rice of exposed households was 5.15percent higher than that of non-exposed households. Reference (6).

Type of quantification: b) Extrapolated estimates
Number: 25000.00
Unit: Farmers
Comments: The Doubly Robust estimator implemented in (6) combines two different approaches to estimate the causal effect of an exposure on the outcome: a specification for the outcome regression and a specification for the exposure. This ensures the robustness of the results because possible forms of misspecification of the model due to selection bias and confounding effects are both considered (8). This methodology (6) allows us to make inferences on the 25,000 farmers involved in the S4N initiative as citizen scientists. With an interval of confidence of 95percent , the Simpson's Diversity Index for rice ranges from 0.61 to 0.66 (value ranges start at 0 (only one variety cultivated) and approach 1 when many varieties are cultivated in equal shares); the Simpson's Diversity Index for wheat will range from 0.60 to 0.65 (the variable values ranged from 0 to 1); the Perceived Change of Yield for rice ranges from 0.73 to 1.02 (the variable values ranged from ?4 (100percent decrease of yield over the last 5 years) to 4 (increase of 100percent or more); the Perceived Change of Yield for wheat will range from 1.193 to 1.50 (the variable values ranged from -4 to +4) and the Recovery capacity from agricultural shocks will range from 1.60 to 1.95 (the variable values ranged from -4 to +4).

Gender, Youth, Capacity Development and Climate Change:
Gender relevance: 0 - Not Targeted
Youth relevance: 0 - Not Targeted
CapDev relevance: 0 - Not Targeted
Climate Change relevance: 1 - Significant
Describe main achievements with specific **Climate Change** relevance: See references (1) and (4)

Other cross-cutting dimensions: NA

Other cross-cutting dimensions description: b) Extrapolated estimates. 25,000 Farmers
The DoublyRobust estimator implemented in (6) combines two different approaches to estimate the causal effect of an exposure on the outcome: a specification for the outcome regression and a specification for the exposure. This ensures the robustness of the results because possible forms of misspecification of the model due to selection bias and confounding effects are both considered (8). This methodology (6) allows us to make inferences on the 25,000 farmers involved in the S4N initiative as citizen scientists. With an interval of confidence of 95%, the Simpson'sDiversityIndex for rice ranges from 0.61 to 0.66 (value ranges start at 0 - only one variety cultivated - and approach 1 when many varieties are cultivated in equal shares); the Simpson'sDiversityIndex for wheat will range from 0.60 to 0.65 (the variable values ranged from 0 to 1); the Perceived Change of Yield for rice ranges from 0.73 to 1.02 (the variable values ranged from −4 (100% decrease of yield over the last 5 years) to 4 (increase of 100% or more); the Perceived Change of Yield for wheat will range from 1.193 to 1.50 (theVariableValuesRangedRrom −4 to +4) andThe RecoveryCapacityFromAgriculturalShocksWillRangeFrom 1.60 to 1.95 (theVariableValuesRangedFrom −4 to +4).

Outcome Impact Case Report link: Study #4340

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