

Research Application Summary

Technology adoption by smallholder farmers: Lessons from the soyabean research/promotion program in Zimbabwe

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Abstract

Agricultural research programs in universities in sub-Saharan Africa generate technologies few of which are adopted by the smallholder farmers. A technology that demands significant additional inputs be they financial or physical is less likely to be adopted compared to one that generates significant socio-economic benefits. In Zimbabwe, smallholders' food security, under threat from declining soil fertility, high fertiliser prices and poor commodity markets persuaded University of Zimbabwe scientists to explore the potential of nitrogen fixing legumes for soil fertility improvement, balanced nutrition and cash income. The technologies tried out included use of Rhizobium inoculants on soyabean, itself a new crop, rotations with staple maize, processing for human and livestock consumption and access to formal markets. The challenge was that both soyabean as a crop and rhizobium inoculant technology were virtually unheard of in the smallholder agricultural sector of Zimbabwe. A Soyabean Promotion Task Force that brought together key stakeholders guided the research and promotion agenda whose major aim was to promote the production, processing, utilisation and marketing of soyabean by smallholders so as to enhance food security, health, farm incomes and soil fertility. An innovation platform made up of key stakeholders was built as the project proceeded and included researchers, extension agents, farmers unions, NGOs, input suppliers, processors, brokers, transporters and bankers to service the soyabean value chain for the benefit of smallholder and newly resettled farmers. The main lesson learnt was that for soyabean technologies to deliver food on farmers tables and cash in their pockets each relevant stakeholder needed to play their part in the value chain. Soyabean's multiple benefits as cash, food and soil improving crop were demonstrated practically and this proved the main driver for adoption. From only 50 farmers in the pilot phase in 1996, the number of adopting farmers exceeded 50,000 by 2003. Smallholder farmers' contribution to formally marketed soyabean rose from 395 tons in 1995 to over 12 000 tons in 2001. The model used had a strong impact on technology adoption as it

addressed food security and has potential for success in similar settings across sub-Saharan Africa.

Key words: Soyabean, inoculants, food security, markets, value chain

Résumé

Les programmes de recherche agricole dans les universités en Afrique sub-saharienne génèrent des rares technologies qui sont adoptés par les petits agriculteurs. Une technologie qui exige d'importants apports supplémentaires qu'elles soient financières ou physiques est moins susceptible d'être adoptée par rapport à celle qui génère d'importantes retombées socio-économiques. Au Zimbabwe, la sécurité alimentaire des petits exploitants, sous la menace de la diminution de la fertilité du sol, du prix élevé des engrais et les marchés des produits pauvres ont persuadé les universités scientifiques de Zimbabwe à explorer le potentiel de fixation de l'azote des légumineuses pour améliorer la fertilité du sol, qui est une alimentation équilibrée et donne un revenu en espèces. Les technologies qui ont été essayées comprenaient l'utilisation d'inoculant de *Rhizobium* sur le soja, elle-même une nouvelle culture, la rotation avec le maïs de base, la transformation pour la consommation humaine et animale et l'accès aux marchés officiels. Le défi a été que, le soja en tant que culture, et de la technologie d'inoculation de rhizobium, étaient pratiquement inconnus dans le secteur des petits exploitants agricoles du Zimbabwe. Un groupe de leader pour la promotion de soja qui a réuni des intervenants clés a guidé le programme de recherche et de promotion dont l'objectif principal était de promouvoir la production, la transformation, l'utilisation et la commercialisation de soja par de petits exploitants afin d'améliorer la sécurité alimentaire, la santé, les revenus agricoles et la fertilité des sols. Une plate-forme d'innovation constituée des principales parties prenantes a été construite comme le projet s'est déroulé et des chercheurs, des agents de vulgarisation, les syndicats d'agriculteurs, ONG, fournisseurs d'intrants, les transformateurs, les courtiers, les transporteurs et les banquiers au service de la chaîne de valeur de soja ont été réalisés au profit des petits exploitants agricoles nouvellement installés. Le principal enseignement appris montre, pour que les technologies de soja puissent livrer de la nourriture sur les tables des agriculteurs et de l'argent dans leurs poches, chaque intervenant pertinent a besoin de jouer un rôle dans la chaîne de valeur. Les multiples avantages de soja en tant que revenu cash, récoltes et culture d'amélioration du sol, ont été pratiquement démontrés et cela s'est avéré comme principal moteur de l'adoption. Pour

seulement 50 agriculteurs de la phase pilote en 1996, le nombre d'agriculteurs adoptant a dépassé 50.000 en 2003. La contribution des agriculteurs des petites exploitations vers le soja commercialisé est officiellement passée de 395 tonnes en 1995 à plus de 12 000 tonnes en 2001. Le modèle utilisé a une forte incidence sur l'adoption de technologies, car il contenait la sécurité alimentaire et a un potentiel de succès dans des contextes similaires en Afrique sub-saharienne.

Mots clés: Soja, inoculants, la sécurité alimentaire, les marchés, la chaîne de valeur

Background

Research programs in universities and national research organisations in sub-Saharan Africa generate useful technologies but adoption rates by the smallholder farmers are very low raising questions about the profitability of such investments by donors and governments. Reasons for non-adoption of agricultural technologies by smallholder farmers include poor targeting, mismatch between technology and needs of beneficiaries, cultural context or socio-economic development. The process of adopting a technology can be likened to a chemical reaction that proceeds rapidly if the activation energy required to get it going is low but very slowly or not at all when the activation energy is high. A technology that requires significant additional inputs (equipment, energy, money), changes in daily/seasonal routines, complex manipulations or even ability to read and write may fail to be adopted even if it has real tangible benefits. Some argue that for adoption researchers must develop the technology together with intended beneficiaries (participatory approach). In Zimbabwe, smallholders' food security, under threat from declining soil fertility in the face of rising unaffordable fertiliser costs persuaded soil scientists to explore the potential of nitrogen fixing legumes for soil fertility improvement. The technology that included the use of Rhizobium inoculants on legumes was already well established in the large scale white-dominated farming sector. Would the smallholder African farmers cope with such sophisticated technology?

Literature Summary

Soyabean, a grain legume whose yields respond significantly to inoculation with rhizobium inoculants (Giller *et al.*, 2000; Mafongoya *et al.*, 2009) was selected as the candidate crop. The challenge was that both soyabean as a crop and rhizobium inoculant technology were virtually unheard of in the smallholder agricultural sector of Zimbabwe (Mpeperekwi *et al.*, 2000). This paper describes how soyabean production using rhizobium

inoculants, a virtually unknown technology among smallholders in Zimbabwe, was integrated into their cropping systems resulting in rapid adoption across all rural provinces of the country.

Study Description

The objectives of the Soyabean Promotion Task Force which guided the research and promotion agenda were to promote the production, processing, utilisation and marketing of soyabean by smallholders so as to enhance food security, health, farm incomes and soil fertility (Pompi *et al.*, 1998). An innovation platform made up of key stakeholders was built up as the project proceeded. Researchers teamed up with extension, farmers unions and input suppliers to provide the required training and inputs. Food scientists came on board to research the most effective but inexpensive methods of processing soyabean for home consumption. As the first crop matured commodity brokers, food processors and transporters were brought in to facilitate marketing. Meanwhile farmers groups were established and took responsibility for organising themselves to access inputs and technical support. Regular stakeholder education and consultative meetings were conducted. The NGOs came on board to take the technology to outlying communities that they worked with. The University researchers and their partners in the NARS and private sector in conjunction with graduate students researched specific issues to do with optimising the soyabean-rhizobium inoculant technology, agronomy, pest and disease control and soyabean as livestock feed. Agricultural economists researched the socio-economic aspects of soyabean production and marketing. The research was demand driven as it sought to unravel constraints in the commodity chain identified by farmers.

Findings

Soyabean responded well to inoculation giving economic yields even in sandy soils prevalent in the smallholder sector farming areas. Inoculation rates recommended for heavy soils were found to be too low for sandy soils. Residual fertility effects of soyabean crops were significant for maize grown in rotation ranging from 0.4 to 1.2 ton/ha. Promiscuous varieties gave higher residual fertility effects compared to specific soyabean varieties that had lower biomass. Claims that soyabean has a higher nitrogen harvest index that depletes soil N were not supported by our data. However, other nutrients like P, K and micro-nutrients need to be provided regularly.

On the promotion aspects, soyabean's multiple benefits as cash, food and soil improving crop were demonstrated practically

(Kasasa *et al.*, 1999; Rusike *et al.*, 2000; Mpepereki *et al.*, 2001) and this resulted in increased adoption. The University scientists researched different facets of the soyabean value chain as it related to smallholder farmers, provided training, technical support and overall co-ordination. From only 50 farmers in the pilot phase in 1996, the number of adopting farmers exceeded 50,000 by 2003. Smallholder farmers' contribution to formally marketed soyabean rose from 395 tons in 1995 to over 12 000 tons in 2001 (Ministry of Lands and Agriculture, 2001). In the process 20 students (17 Masters, 3 PhDs) graduated with theses topics ranging from rhizobium inoculant technology, agronomy, pests and diseases, processing and marketing of soyabeans. The critical importance of establishing stakeholder linkages along the value chain from production, processing, to marketing and utilisation of the crop was demonstrated.

Research Application

The model used had a strong impact on technology adoption as it addressed food security and has potential for success in similar settings across sub-Saharan Africa. The main elements were bio-physical research targeted at adapting soyabean technologies to smallholder conditions resulting in science-based extension messages e.g. increasing inoculation rates in sandy soils. Soyabean was shown to improve food security and health (especially HIV/AIDS patients), soil fertility for maize, feeds for livestock and cash income from grain sales. It is a potent tool to fight the twin evils of poverty and food insecurity among smallholder farmers (Rusike *et al.*, 2000). The focus on ensuring that markets worked for the smallholders was critical for technology adoption.

Recommendation

For technologies to be adopted, they must address the basic day to day needs of target communities such as requirements for food and cash income. Promoters must ensure that tangible benefits are realised by beneficiaries. For commodities links to lucrative markets drive technology adoption. Linking stakeholders along the whole value chain increases the chances of success. Research must aim to adapt, modify or repackage technologies to suit the needs of the target group.

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