

Which aid initiatives strengthen food security? Lessons from Uttar Pradesh

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WHICH AID INITIATIVES STRENGTHEN FOOD SECURITY?

LESSONS FROM UTTAR PRADESH

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Short biography

Ivica Petrikova is a lecturer in International Relations and Development at the Royal Holloway, University of London. Her research interests include aid effectiveness, food security, good governance, and social capital.

David Hudson is a senior lecturer in Political Economy of Development at University College London, University of London. His research interests include development finance, public opinion analysis, and development policy management.

Abstract

This study contributes to existing research on the relative effectiveness of aid initiatives in addressing food insecurity in India. Specifically, it compares the effects of crop, livestock, credit, and WASH interventions implemented by a development NGO with the impacts of a public direct-transfer scheme on food security among communities in Uttar Pradesh. The NGO's agricultural and WASH interventions and the government's Antyodaya ration-card scheme appear to have the largest positive influence. Their positive impact can be enhanced by the presence of good governance and by the simultaneous application of several beneficial initiatives.

Keywords: NGO aid, aid effectiveness, food security, Uttar Pradesh, India

Introduction

In the last two decades, global food security experienced a significant improvement, as evidenced by performance assessment of the first Millennium Development Goal, which vowed to reduce world hunger by half. However, the progress in South Asia on the food-security front has been slow, despite a steady rate of economic growth – a phenomenon branded by researchers the ‘South Asian enigma’ (e.g. Ramalingaswami et al. 1997). To illustrate, whilst the rate of stunted (1) children in developing countries overall declined from 40 per cent

in 1990 to 24 per cent in 2014, 37 per cent of South Asian children still suffered from stunting in 2014 (WHO 2016). Researchers warn that food security in the region may become further compromised by climate-change-driven extreme weather conditions, declining cereal yields, and increasing meat consumption amongst growing middle classes (Pachauri et al. 2014).

Although the relative importance of external assistance in addressing development challenges in the region has waned over time, donors still channel a large amount of aid through projects aimed at bolstering South Asian food security. According to the Organisation for Economic Co-operation and Development (OECD), in 2014 more than two billion USD were disbursed for this purpose (OECD 2016). The specific activities funded range from the provision of food aid through agricultural and economic to sanitation support; nevertheless, little research exists on their relative effectiveness. The main objective of this article is to contribute to accumulating evidence in this regard, by comparing the impact of several different development initiatives on participants' food security. We do so by analysing quantitative and qualitative data gathered in Uttar Pradesh (UP), India between 2012 and 2014. The findings are consequently most applicable to north-eastern India but offer, we daresay, some generalizable lessons also to the region at large.

This article is structured as follows. The next section reviews the existing literature on different types of development projects and their impacts on food security. The third section talks about the current state of food insecurity in India, with a particular focus on Uttar Pradesh. The fourth section discusses the chosen methodology and the fifth presents an overview of the data utilised. The last sections display results from the different analyses, discuss their significance, and offer some concluding remarks.

Food security and its link with different aid initiatives

The Food and Agriculture Organisation (FAO) defines food security as 'access by all people at all times to sufficient food to meet dietary needs for a productive and healthy life'. Food security rests on four pillars: sufficient food availability, access to food, food utilisation, and stability of food supply. Aid initiatives usually focus on only one or two of these aspects when trying to strengthen food security. Accordingly, they can be divided into four broad categories: agricultural, economic, social, and direct-transfer projects (following OECD's aid classification in the Creditor Reporting System; also Petrikova 2014). Agricultural projects mostly aim to increase agricultural production, whether for farmers' own consumption or retail, and hence may bolster the first two food-security pillars. Economic projects, such as business-training or microfinance schemes, can improve participants' food security particularly via the

food-access route. Social-infrastructure projects directly related to food security include primarily water, sanitation, and hygiene (WASH) initiatives and nutritional education, which target the food-utilisation pillar. Finally, direct transfers of food or cash may raise people's access to food and if in place for the long term, also future stability. As noted above, there is not much research on the *relative* effectiveness of the different initiatives in strengthening food security; however, the following paragraphs briefly summarise evidence on their *absolute* effectiveness.

Effect of different aid interventions on recipients' food security

Existing research has examined primarily the effects of agricultural projects on recipients' food security. Several rigorous meta-analyses (e.g. Berti et al. 2003; IYCN 2011; Massett et al. 2012) suggest that agricultural interventions help raise crop production, which sometimes but not always translates into higher food security. Encouraging the cultivation of foods consumed by project participants is deemed to be particularly helpful, as it contributes to higher household dietary diversity scores (IYCN 2011). These findings apply to India as well, where a special emphasis has been placed on the benefits of agro-ecological crop intensification (Abraham et al. 2014). Support to livestock constitutes a separate niche within agricultural interventions and has been found to generally strengthen recipients' food security (e.g. meta-analysis by Leroy and Frogillo, 2007). In South Asia and Africa, livestock projects have in addition been shown to have a female-empowerment potential (Kristjanson et al. 2014).

Economic projects focused on food security aim to increase people's incomes and include primarily microfinance and business-training activities. Conclusions regarding their impact have been mixed. Some studies found them to improve nutritional outcomes generally (e.g. Schrieder and Sharma 1999), others only among more involved households (e.g. Copestake et al. 2000). The results from India have been similarly ambiguous, suggesting that microfinance and business projects may empower female participants (Datta 2015) but that access to financial services other than loans is often more helpful (Imai et al. 2010). Recent evidence from randomised control trials of microfinance (Banerjee et al. 2015) from six countries, including India, found little evidence of impact on poverty reduction or food access.

Social projects that target food security are predominantly water, sanitation, and hygiene and nutritional-education schemes. WASH interventions have been examined mainly for their effects on health and found to reduce, on average, rates of diarrhoea, which could further improve food utilisation (Fewtrell et al. 2005). However, a recent randomised control trial of a rural sanitation programme in Odisha, India discovered no significant impact on recipients, due

to lack of governmental support (Clasen et al 2014). Vis-à-vis nutritional education, existing research has shown the promotion of breast feeding and complementary infant feeding as well as nutritional-education components of agricultural projects to improve recipients' nutritional outcomes by reducing nutritional deficiencies (Bhutta et al. 2008; IYCN 2011).

Direct-transfer schemes of cash and food have also an ambiguous record in attempting to strengthen food security. Cash transfers are viewed as possibly more useful since food transfers may inadvertently price out local producers; nonetheless, not always do higher incomes lead to higher or better food consumption (Del Ninno et al. 2005). India operates a nation-wide food-transfer scheme, the Public Distribution System (PDS), which allows targeted poor population to purchase staple foods at symbolic prices. Due to leakages and corruption in the programme, however, most studies did not discover the scheme to bolster food security (Kaushal and Muchomba 2013; Kochhar 2005).

Gaps in literature and way forward

Existing research, as briefly summarised above, suggests that all four different types of interventions, whether in India or elsewhere, *may* improve recipients' food security, depending on their specific context and activities involved. Nevertheless, due to a paucity of studies comparing the effects of more than one type of intervention on food security, it is hard to hypothesise which interventions are more helpful in this regard than others. Because agricultural projects aim to specifically increase food production and calls for increasing agricultural investment in developing countries followed the 2007-8 food crisis, we conjecture that agricultural interventions are likely more successful at reducing food insecurity in our study than other interventions (Hypothesis). However, to a large extent our main question remains an open matter of empirical investigation. The main contribution of this study is thus evidence on the relative effectiveness of agricultural, economic, social-infrastructure, and direct-transfer interventions on the food security of their beneficiaries in northern Uttar Pradesh, India. The location of the case study is suitable since the state of food insecurity in the area, as the following section illustrates, remains serious.

State of food insecurity in India (Uttar Pradesh)

Despite high rates of economic growth over the past two decades, averaging at 7 per cent, India's food insecurity for 2015 is still classified as 'serious' by the Global Hunger Index (GHI), placing it above many significantly poorer countries including Togo, Malawi, and Guinea (2) (GHI 2016). According to the latest data available, 15 per cent of India's adult

population lacks access to a sufficient amount of daily calories, 40 per cent of children under five years of age are underweight, and 48 per cent of children are stunted (WHO 2016). The afore-mentioned ‘South Asian’ enigma has received increasing academic attention, with explanations of the root cause ranging from gender discrimination (Jayachandran and Pande 2012) through absence of agricultural or pro-poor growth (Gillespie 2013; Drèze and Sen 2013) to a poor state of hygiene due to high rates of open defecation (Spears 2013).

The state of food insecurity in Uttar Pradesh is even more serious than in India on average. This is not particularly surprising since the GDP per capita in the state is second lowest, after Bihar, among India’s 33 states and Union territories (World Food Programme [WFP] 2010). The state’s food security atlas estimates that 57 per cent of children under five in the state are stunted and 42 per cent are underweight (WFP 2010). One third of all adults are undernourished as compared to the 15-per-cent national average. Low literacy rates and high gender inequality (3) are denounced by the WFP (2010) as main sources of Uttar Pradesh’s food insecurity; however, they likely are simultaneously its consequences.

Methodology

This section first introduces the NGO project and the government scheme examined in this study. Proceeding, we describe the process of the quantitative and qualitative data collection and explain the methods of data analysis utilised.

Project in Uttar Pradesh and implementing NGO

The development project examined has been implemented among households in 20 villages in four UP districts – Siddharth Nagar, Maharajganj, Gorakhpur, and Sant Kabir Nagar – since 2005. The communities lie in the basin of the Rapti River. They are still largely unconnected by paved roads, which has stifled progress in human development indicators including child mortality and literacy rates (WFP 2010). Agriculture has traditionally been the main means of people’s living but due to increasing population pressure, it is becoming economically unviable for many farmers. Consequently, there is an emergent crisis of livelihoods along with serious food insecurity in the area (*ibid*). The project-implementing NGO (4) has tried to address these issues through agricultural (crop and livestock), economic, and sanitation/hygiene interventions, representing three of the four categories of food-security projects discussed in this article.

Figure 1. Location of the study



Source: map from geography.about.com, location drawn by authors

The implementing NGO operates only in northern India but is part of several international NGO coalitions. In the last five years it had an average annual income of 300,000 USD, approximately one third of which was received from foreign donors, including DFID and UNDP, and two thirds from domestic donors.

Crop intervention: The main focus of the project's crop intervention is to increase crop productivity. The arable land in the project area is used primarily for rice cultivation and is very flood-prone. The main activity within the project's crop intervention has thus been the provision of subsidised hybrid rice seeds that allow farmers to harvest rice crop before the full onset of floods, as the hybrid rice matures faster than traditional rice varieties. The project has also supported participants in vegetable cultivation for domestic consumption.

Livestock intervention: The aim of this intervention is to improve the breed, health, and productivity of domestic animals. The main activity is the provision of basic veterinary care

and artificial insemination services for breed improvement. In 2014, through this project component approximately 2000 cows and buffaloes were artificially inseminated, over 9000 animals were vaccinated, and 850 animals were provided with de-worming medication.

Economic/credit intervention: Within this component, the NGO has encouraged the establishment of self-help groups for micro-finance. It has not created a microfinance institution itself but has tried to promote and capacitate the communities participating in the project to manage their own saving and lending operations. The resultant available credit sometimes facilitates the set-up or expansion of microenterprises, including tea stalls and a grocery shop, but it has also been frequently used to cover medical expenses and weddings.

Water, Sanitation, and Hygiene (WASH) intervention: The objective of the WASH component is to improve hygiene and sanitation practices and conditions among the targeted communities. The main activities within this initiative involve the construction of toilets in household premises – in cooperation with the village authorities - and awareness-raising about the dangers of open defecation, safe water drinking, handling of sewage, and waste disposal management.

Public Distribution System (5)

Many people surveyed in this study reported to have benefitted also from PDS, India's largest national food-security initiative. The scheme allows people with ration cards to purchase basic cereals (rice, wheat, and coarse grains) at subsidised prices from special Fair Price Shops. The ration cards are of three different types - Above-Poverty Line (APL), Below-Poverty Line (BPL), and Antyodaya Anna Yojana (AAY) – with AAY cards (6) offering the most benefits and APL the least. Specific eligibility criteria for obtaining the cards slightly vary by state; however, in general applications, made locally, need to be accompanied with a proof of address and income statements or means-assessments by community leaders. Much decision power vis-à-vis the scheme's implementation thus rests with state and local authorities, many of whom have greatly abused it for personal enrichment (Kaushal and Muchomba 2013).

From the perspective of the intervention's approach to tackling food security, the PDS is essentially a targeted direct-transfer safety net. As such, it can be analysed as representative of the fourth category of our food-security project classification, not represented here by any of the NGO interventions.

Data collection

Both quantitative and qualitative data were collected in the communities under study. Quantitative data were gathered using household surveys administered between December 2012 and March 2013 to 146 households that have benefitted from at least one of the project's components and to 23 households in villages that did not participate in the project. First, eight villages from the project-participating ones and three from the non-participating ones in close geographical proximity were selected at random to be examined. Second, from each village five to fifteen households, depending on the size of the community, were randomly selected and surveyed. The surveys inquired about the households' receipt of project and PDS assistance, their demographic data (members, their age, education levels, and religious affiliation), their income and asset ownership, and their food security.

Qualitative data were collected in March 2014, through a series of long, semi-structured interviews with household members from 15 previously-surveyed households. The main objectives underlying the second round of data collection were to gain a deeper understanding of the results obtained through the quantitative analysis.

Analytical methods

The first approach that we use to estimate the effect of the different interventions on recipients' food security is Propensity Score Matching (PSM), which allows for impact evaluation in the absence of panel data. This quasi-experimental approach is based on the construction of a control group to the treated one using data on observable characteristics. The outcome indicators of the synthetic control group are then subtracted from the treatment group's to determine the significance and size of the interventions' impact – the Average Treatment Effect on the Treated (ATET).

In order to assess robustness of the PSM results, as a second evaluative approach we use Ordered Probit regressions, with robust standard errors clustered by household, with food security as the dependent variable and the different interventions as the main independent variables. The qualitative data from semi-structured interviews are analysed via simple content analysis to provide depth and explanatory power to the quantitative findings.

Data and summary statistics

Food (in)security – Dependent variable

Table 1 displays summary statistics of variables used in the study. The main dependent variable is a food-insecurity index, constructed from four questions inquiring about 1) the adequacy of households' food consumption, 2) food availability in the previous year, 3) concerns about future food availability, and 4) frequency with which household members would have preferred to eat other foods. (7) The index values vary from 3 to 11 (high food insecurity), with the average at 7.

Two other food-insecurity measures utilised are the number of different food groups a person consumes per average main meal, as a measure of household dietary diversity (mean of 2.53), and the number of times a respondent experienced diarrhoea in the past month (on average between two and three times). Most indicators of food insecurity were adopted from food-security modules used by the World Bank's Living Standard Measurement Surveys (LSMS) (8); the question about diarrhoea was added in view of India's potential link between food insecurity and sanitation issues mentioned earlier.

The last dependent variable, *financial situation*, also adopted from the LSMS surveys, speaks more about overall financial wellbeing than just food security. It inquired of surveyed households whether they were concerned about their financial situation in the next year, with results ranging from 1 (little concern) to 4 (grave concern). The average falls at 2.37. Together, the dependent variables' summary statistics thus paint a picture of intermediate food insecurity in the villages surveyed, with people fairly worried about their future prospects.

An obvious deficiency of the dependent variables is their subjective nature. Collecting data on nutritional measurements (e.g. BMI) was considered but eventually declined due to the operational difficulties involved in gathering such data. The usage of several food-insecurity measures coupled with the use of qualitative data should compensate for the bias introduced by the variables' subjective nature. Additionally, food-insecurity and dietary diversity indices may be preferable to nutritional indicators when estimating food insecurity as they capture people's feelings of anxiety and fear about food even among people consuming a sufficiently caloric diet (Barrett 2002).

Intervention types – Main independent variables

The *project* variable indicates whether a respondent has been a beneficiary of any of the NGO project components. Out of the 1257 people surveyed, 1110 (88 per cent) received at

least one of the components. The following four variables provide the same information vis-à-vis the project's separate interventions – crop, livestock, credit, and WASH. The results in Table 1 show that 81 per cent of respondents received help from the NGO with crops, 69 per cent credit support, 46 per cent livestock help, and 25 per cent WASH support.

Table 1. Descriptive statistics of all variables analysed

	Mean	Std. Dev.	Min	Max
<i>Food insecurity measures</i>				
Food insecurity index	6.91	1.90	3	11
Satisfaction level with food consumption	2.11	0.48	1	3
Future concern about food	2.20	0.74	1	4
Would prefer other foods	0.79	0.60	0	2
Food availability over previous year	1.21	0.41	1	2
No. of food groups per avg main meal	2.53	0.19	2	4
Diarrhoea per month	2.69	1.35	0	7.5
Financial concern for next year	2.37	0.77	1	4
<i>External assistance variables</i>				
NGO project	0.88	0.32	0	1
Crop component	0.81	0.39	0	1
Livestock component	0.46	0.50	0	1
Credit component	0.69	0.46	0	1
Wash component	0.25	0.43	0	1
PDS ration card	0.62	0.49	0	1
AAY card	0.28	0.45	0	1
BPL card	0.31	0.46	0	1
APL card	0.03	0.18	0	1
<i>Control variables</i>				
Male	0.54	0.50	0	1
Age	26.24	19.22	0	90
Education, yrs completed (for respondents>22yrs)	3.44	4.54	0	18
Hh size	9.56	4.88	1	24
Female headed hh	0.13	0.34	0	1
Muslim	0.03	0.18	0	1
Scheduled caste/tribe	0.71	0.12	0	1
Pucca' house	0.64	0.48	0	1
Wealth index	0.22	0.33	0.00	1.00
Income per capita (USD)	86.74	45.95	26.20	392.93
N	1257			

Source: authors' own calculations

The next four variables provide information about the PDS scheme. *Ration card* shows that 62 per cent of the individuals surveyed lived in households holding a PDS ration card. 28 per cent

of respondents had access to an AAY card, 31 per cent to a BPL card, and 3 per cent to an APL card.

Control variables

Two groups of control variables were utilised. The first one, demographics, includes gender, age, education, religion, caste, household size, and whether a household is female-headed. The second group gauges households' economic status, by inquiring about their annual income, type of dwelling ('pucca' or 'kachcha') (9), and whether they own any valuable items (toilet, water pump, watch, pressure cooker, radio, fridge, TV, phone, sewing machine, fan, bicycle or a motorcycle).

Looking first at the demographics, 54 per cent of the sample is male, with the average age around 26 years. The mean number of years of schooling completed by adult respondents is 3.44, with a large range from zero to 18. 13 per cent of respondents lived in female-headed households, 71 per cent came from scheduled castes/tribes, and only 3 per cent were Muslim. The average household size is close to ten.

Turning attention to indicators of economic wellbeing, 64 per cent of respondents lived in 'pucca' houses. Data on the possession of valuable items were compiled into a wealth index, using Principal Component Analysis, with the resultant mean around 0.22 on a 0-to-1 scale. Finally, the average per capita income in our sample is extremely low, less than 85 USD annually (<25 cents per day). This number, however, does not include the value of the crops grown and consumed domestically.

Results

To establish a basis for further results, we first present a comparison of the effects of the NGO project in general with the effects of the PDS scheme on recipients' food security. As a second step, we examine the relative effectiveness of the different intervention types. We finish with an analysis of the impact of the different interventions when applied in different combinations.

Impacts of the NGO Project and PDS on recipients' food security

The first part of Table 2 shows the effects of the NGO project on recipients' food security. The impact appears overall positive, with the most robust effect on reducing the frequency of diarrhoea in the past month but also reducing the food-insecurity index. The interviews corroborated these findings as all the interviewed beneficiaries of the project asserted that the

NGO assistance helped them improve their food security. Paradoxically, Table 2 also suggests that the project might have somewhat increased people's financial concerns. In interviews, project recipients to some extent clarified this result by mentioning that even though they were doing better thanks to the project, they were becoming worried about its future due to the approaching elections (spring 2014) and potential change in government (10).

Table 2. Impact of the NGO project and PDS on recipients' food security

	<i>Model</i>	Food insecurity index	Food groups per meal	Diarrhoea per month	Financial concern
NGO project	<i>PSM</i>	-0.01	0.00	-0.54	0.23
		<i>0.05</i>	<i>0.34</i>	4.43	3.52
	<i>Ordered Probit</i>	-0.57	0.12	-0.16	0.00
		1.83	<i>0.55</i>	1.78	<i>0.02</i>
PDS	<i>PSM</i>	-0.23	-0.02	-0.11	0.01
		<i>1.48</i>	<i>1.52</i>	<i>0.95</i>	<i>0.12</i>
	<i>Ordered Probit</i>	-0.04	-0.25	-0.34	0.16
		<i>0.18</i>	<i>1.01</i>	1.80	<i>0.67</i>

The number next to each variable is the ATET/coefficient, the number below is the corresponding Z score. Results significant at least at the 90% level are in bold.

Unlike the NGO project, the PDS scheme appears ineffective at strengthening food security. That could seem surprising; the ability to purchase staple cereals at very low prices should theoretically bolster recipients' food security at least to some extent. However, the interviewees elucidated this result with explanations about the programme's corrupt nature, both when trying to obtain a ration card and when trying to use it, with one respondent saying:

'Often, when I go to the Fair Price Shop, they tell me that they have run out of stock ... but I know they have stock for their friends.'

This finding falls in line with other authors' (e.g. Kaushal and Muchomba, 2013; Kochhar, 2005) discoveries that the PDS had no measurable impact on food security due to the scheme's leakage and under-coverage problems, mostly related to corruption. The recent attempt to connect the PDS cards with biometric identification numbers (aadhaar) may help reduce the programme's proliferated corruption (Masiero 2015).

From the un-displayed control variables, the wealth index appeared to be the most significant in strengthening food security. Conversely, living in a female-headed household or being female increased the likelihood of food insecurity.

Heterogeneous impact of different initiatives

Table 3 displays results of a comparative impact analysis of the four different components of the NGO project. The crop intervention reduced the food-insecurity index and diarrhoea incidence and robustly bolstered the number of different food groups consumed. This finding, according to the interviews, owes thanks to the project helping beneficiaries grow new types of vegetables for domestic consumption and purchase more dairy and meat thanks to increased incomes. Imperceptible from the regression results is also the fact, however, that for several farmers the introduction of the new hybrid rice seeds by the project backfired one season when the rice crop failed. This would likely not have happened with the traditional rice varieties, which were grown as a ‘mix’ precisely for risk-mitigating purposes.

Table 3. Heterogeneous impact of different project components on recipients' food security

NGO project	Model	Food insecurity index	Food groups per meal	Diarrhoea per month	Financial concern
Crop	<i>PSM</i>	-0.47 1.69	0.04 5.98	-0.99 2.85	-0.20 1.39
	<i>Ordered Probit</i>	-0.26 0.90	0.35 1.67	-0.20 0.84	-0.18 0.65
	<i>PSM</i>	-0.61 2.99	0.03 2.16	-0.02 0.12	-0.46 2.93
	<i>Ordered Probit</i>	-0.19 1.72	0.32 0.89	-0.21 1.49	-0.26 1.27
Credit	<i>PSM</i>	0.25 1.26	-0.01 0.26	0.00 0.01	0.37 1.45
	<i>Ordered Probit</i>	0.32 0.19	-0.42 1.35	-0.20 0.65	0.51 1.89
	<i>PSM</i>	-0.46 2.57	0.10 1.16	-0.63 5.37	-0.59 8.45
	<i>Ordered Probit</i>	-0.22 1.68	0.47 1.19	-0.90 4.01	-0.73 2.63

The number next to each variable is the ATET/coefficient, the number below is the corresponding Z score. Results significant at least at the 90% level are in bold.

The livestock component also increased the number of food groups consumed and most effectively lowered recipients' food-insecurity index. It also reduced their financial concerns. The last effect, according to the interviewees, is related to the increase in recipients' animal ownership thanks to the NGO's help with livestock breeding and care. Since poor people regard domestic animals as a form of saving, their financial worries decline as their animal stock increases (Fafchamps et al. 1998). Owning more/healthier animals has simultaneously led to higher dietary diversification thanks to higher consumption of dairy and meat.

The credit part of the project has performed the worst from the viewpoint of the recipients' food security. Table 3 reveals that its effect on most outcome variables was insignificant. One result even insinuates that the microloans might have heightened people's financial concerns.

This finding can logically be attributed to people's fears about loan repayment. The four interviewed women who borrowed from the NGO-supported self-help groups all used the money to cover consumption rather than production costs (medical expenses and weddings) and the repayment of the loans subsequently strained their household budgets. Nevertheless, people who have taken loans from the credit groups would have perhaps borrowed money even in their absence, from local money lenders charging higher interest rates, and thus the no impact on food security discovered *might* be obfuscating the loans' consumption-smoothing role.

The WASH component reduced recipients' food-insecurity index, comparably in size and consistency to the crop component. It also significantly lowered the frequency of recipients' diarrhoea. One of the interviewees illustrated the finding:

'One of the greatest services [the NGO] has given us is the toilet. Earlier, there were lots of flies and insects. Kids used to get lots of diseases... [and] run around the house with stained legs. Now that we have the toilet, things are better.'

Interestingly, the recipients' financial concerns also decreased in response to the WASH intervention, perhaps thanks to the realization that better sanitation was likely to render households healthier and in less need of credit to cover emergency health costs.

Table 4 compares the impact of the three PDS ration cards on recipients' food security, to examine whether different specifics in the direct-transfer scheme influence its effects. Unlike the PDS scheme overall, the AAY card unequivocally strengthens food security. The effect appears even more consistently positive than any of the project's components. In contrast, neither the BPL nor the APL card have a significantly positive impact in this regard. The interviewees explained these findings by pointing out that when stocks of rationed food in shops were low, only AAY card holders were allowed purchasing. Consequently, most bribery and corruption surrounded the distribution of the AAY card ownership. Another reason for AAY's greater effectiveness is that the AAY cards allow holders to purchase more grains at slightly lower prices than the other two PDS cards. India's National Food Security Act, signed in 2013 and gradually implemented since 2015, aims to guarantee national food security by extending the AAY benefits to 75 per cent rural and 50 per cent urban population (NFSA 2013), which, as the result here suggests, could have the potential to succeed as long as it does not become too undermined by corruption.

Table 4. Heterogeneous impact of different PDS ration cards on recipients' food security

PDS	Model	Food insecurity index	Food groups per meal	Diarrhoea per month	Financial concern
AAY	PSM	-0.42	0.03	-0.18	-0.22
		3.24	2.82	1.76	4.30
	Ordered Probit	-0.16	0.32	-0.45	-0.21
		1.89	2.71	1.75	2.25
BPL	PSM	0.63	-0.05	-0.54	0.62
		1.48	1.13	1.28	3.80
	Ordered Probit	0.04	-0.87	-0.28	0.47
		0.16	2.69	1.43	2.00
APL	PSM	-0.08	0.01	0.05	-0.14
		0.21	1.05	0.20	1.56
	Ordered Probit	0.16	-0.04	0.08	0.21
		0.32	0.12	0.19	1.10

The number next to each variable is the ATET/coefficient, the number below is the corresponding Z score. Results significant at least at the 90% level are in bold.

Compound impact of the different aid initiatives

In order to assess whether the positive effects of the different aid interventions on food security increase when more than one is implemented simultaneously, as the final step in our analysis we conducted a PSM evaluation of the compound effects of the different NGO and PDS components on household food-insecurity index. (11) Table 5 shows that the livestock component in combination with WASH and crop components have the most sizeable effect on food security. Interestingly, the size of the impact is larger than the sum of the positive effects of the three individual components, highlighting the existence of synergy among the three interventions. One interviewee illuminated this finding:

'Through the agricultural intervention I started growing more vegetables; the livestock component helped me get a second cow. And I got the toilet...now my kids eat more food, drink more milk, and they are ill less often.'

Livestock help joined with WASH and AAY also significantly reduce the food-insecurity index but not as much as the crop-livestock-WASH combination, suggesting that those in receipt of productive help from the NGO no longer rely to the same extent on subsidised food from the government.

Discussion and concluding remarks

The main objective of this article has been to contribute to literature on the relative effectiveness of interventions in strengthening household and individual food security by comparing the impact of four different NGO interventions – crop, livestock, credit, and WASH - and of a government food-transfer scheme among rural communities in northern Uttar

Pradesh. Each of the interventions analysed falls under one type of the project classification by food-security approach formulated at the beginning of this article. The crop and livestock components of the NGO project represent different kinds of agricultural interventions while the credit component can be classified as an economic and the WASH component as a social-infrastructure intervention. The three PDS ration cards examined constitute a form of direct transfer of food, with varying concessional levels. Our original hypothesis, based on existing research, was that agricultural interventions are more successful at boosting food security than other types.

The findings to some extent support this hypothesis. When looking at the food-insecurity index, the main measure of food insecurity utilised, the livestock agricultural intervention indeed appears to have reduced it most effectively, followed closely in size and significance by the WASH intervention and the AAY card. The crop intervention also lowered the food-insecurity index, but the result is less robust than in the previous cases. A possibly more positive finding on the effect of the crop intervention may have been undermined, as the interviews suggested, by a season when the NGO-introduced hybrid rice crop largely failed and some farmers were consequently driven into debt. The credit project component and the BPL and APL ration cards had apparently no effect on the food-insecurity index.

Results on the other dependent variables largely align with the above. The crop intervention followed by the AAY card and livestock intervention were most successful in boosting dietary diversity while the WASH intervention in tackling diarrhoea. The crop and livestock project components augmented the variety of food intake by helping recipients produce more food (vegetables, meat, dairy), for both domestic consumption and the market. In contrast, the AAY cards enable holders to purchase staple grains at below-market prices, which frees up their funds to purchase other food groups than cereals. The BPL and APL cards did not have this positive effect because they confer fewer benefits than the AAY cards and, as the interviews explained, because in case of (frequently) insufficient PDS stocks only AAY card holders can buy the subsidised food. WASH beneficiaries received in-household toilets along with sanitation education, explaining the subsequent reduction in the incidence of diarrhoea, which then translated into a lower food-insecurity index and higher financial security as well.

The in-depth interviews along with examination of the combined impact of the different interventions helped us reach two further conclusions. First, while the conditioning role of governance in aid effectiveness was not examined specifically, some of the results reached indicate that the positive impact of aid initiatives could be significantly enhanced in an environment with better quality institutions and less corruption, particularly evident in the

administration of the PDS. The second conclusion has to do with the importance of application of different aid initiatives simultaneously. Existing research (e.g. IYCN 2011) has indicated that multi-sector development projects tend to be more successful at achieving desired outcomes than projects focused only on one sector. The results of our analysis provide empathetic empirical support to this argument. People who received agricultural help (both crop and livestock) along with WASH support benefitted the most in terms of food security, with the size of the reduction in food-insecurity index larger than a simple sum of the three components' separate coefficients.

What do findings from this study imply for development projects working on food security in India more generally? First, they suggest that agricultural support may significantly strengthen food security among Indian subsistence farmers even today, despite increasing claims about the non-viability of small farms. (12) Particularly the livestock intervention seemed beneficial here, with animals serving both as a source of income and food and as a guarantee of financial security. However, the incident with failed hybrid-rice harvest simultaneously urges interventions to be cautious about uprooting long-established risk-mitigation mechanisms. Second, the results highlight the effectiveness of sanitation and hygiene interventions in improving food security, providing support to the link between open defecation and high Indian food insecurity drawn by Spears (2013). Third, the findings indicate that microcredit projects can be ineffective at reducing food insecurity, particularly when not used for productive reasons. That, however, does not mean that they do not serve any development purpose, as their consumption-smoothing effect, for example, has not been specifically analysed here. Fourth, our findings reinforce the view that the quality of institutions, both on the national and on the local level (e.g. Hudson 2015), and the simultaneous provision of assistance on several fronts play an important role in strengthening the effectiveness of aid and other assistance programmes.

One area that this study failed to examine in greater detail is the link between food insecurity and gender. The quantitative results showed that women in our study suffered more from food insecurity than men. Literature suggests that increasing female livestock ownership can serve as a remedy in such situations (e.g. Kristjanson et al. 2014), as can female participation in microfinance. The latter does not appear to have happened in the villages we surveyed; we hope to examine the effects of the former closer in our future research in the area.

Notes

- (1) Short for their age
- (2) WDI (2016) estimates India's GDP per capita for 2014 to be 1581 USD, while Togo's 636 USD, Guinea's 540 USD, and Malawi's 255 USD.
- (3) In Uttar Pradesh, 60 per cent adult males compared to 38 per cent females are literate (WFP 2010).
- (4) The NGO expressed a preference not to be named in our initial agreement.
- (5) More information about PDS at <http://pdspotal.nic.in/main.aspx>.
- (6) The AAY cards were established to provide extra food-security support to the 25 million poorest people in India.
- (7) The index was meant to include two more questions – the frequency with which households lacked food in the house and had to skip meals – but the response pool exhibited no variation and hence the questions were excluded. Due to low response variation, we omitted further two dependent variables – number of meals per day and of illness over past six months.
- (8) E.g. http://siteresources.worldbank.org/INTLSMS/Resources/3358986-1181743055198/3877319-1273055371047/TJ_Pan_09_V11.pdf
- (9) 'Pucca' houses are constructed from firm materials whereas 'kachcha' houses of temporary materials.
- (10) Their worries turned out to be warranted to some extent, as the Indian government that assumed power in 2014 made it more difficult for Indian NGOs to continue receiving foreign funding. However, the project under examination continues.
- (11) The table contains only combinations of interventions observable in our sample in more than three households.
- (12) That is not to trivialise the many challenges faced by Indian small farmers or de-politicise larger political economy issues including land rights and land distribution.

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