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Introduction

The movement of cassava planting material (hereafter 'seed') has important implications for varietal dissemination, pest and disease spread, and other aspects of the production environment. Despite the > 3.5 M ha of cassava grown annually in Southeast Asia, little research has been conducted to date on the production and dissemination of seed. To understand existing seed use and exchange, we conducted the first national-scale baseline evaluation of cassava seed systems in Vietnam and Cambodia in the 2016-2017 field season.

Materials and methods

Seed exchanges in 2016 were identified through household surveys conducted between Nov.-Dec. in 16 districts in Cambodia ($n = 240$) and 15 districts in Vietnam ($n = 206$), representing each country's areas of significant cassava production. We interviewed the household member most involved with cassava production, and gathered information on respondents, seed use and management, and field and household data. Seed exchanges in the past cropping season were used to evaluate baseline seed use. To map exchange networks, recorded seed exchanges were aggregated to an adjacency matrix, and a network graph was constructed with provinces as nodes and seed exchanges as links, using R's *dplyr* and *igraph* packages, and custom code. Link weights were calibrated by dividing the total number of stakes by the number of farmers surveyed in the "source" province to estimate numbers of stakes exchanged per household.

Results

Seed exchange was conducted through a predominantly farmer-managed system, with very little direct involvement from industry or government (Table 1). Most exchanges (71 and 90% in Cambodia and Vietnam, respectively) took place within the community (Fig. 1). However, a robust network of specialized trader agents linked to root value chains supplied 18 and 3% of farmers with stakes in Cambodia and Vietnam, respectively. Traders were also important buyers of stakes in Vietnam, but not in Cambodia. This dynamic created a robust exchange

Table 1. Seed source and acquisition types reported in Cambodia (KH) and Vietnam (VN) in 2016, presented as percentages of total recorded seed acquisition (Ac.) and seed provision (P.) exchanges.

Seed source	KH		VN	
	Ac.	P.	Ac.	P.
Own stock	47		64	
Acquaintance (within community)	26	82	20	78
Acquaintance (outside community)	4	0	4	1
Other farmer (non-acquaintance)	3	18	1	13
Local market	1	0	0	0
Agroinput dealer	0	0	6	0
Starch factory	1	0	0	0
Trader	18	0	3	9
Municipality / district office	0	0	1	0
Total N transactions	381	130	234	104
Sample N (individuals)	240		206	

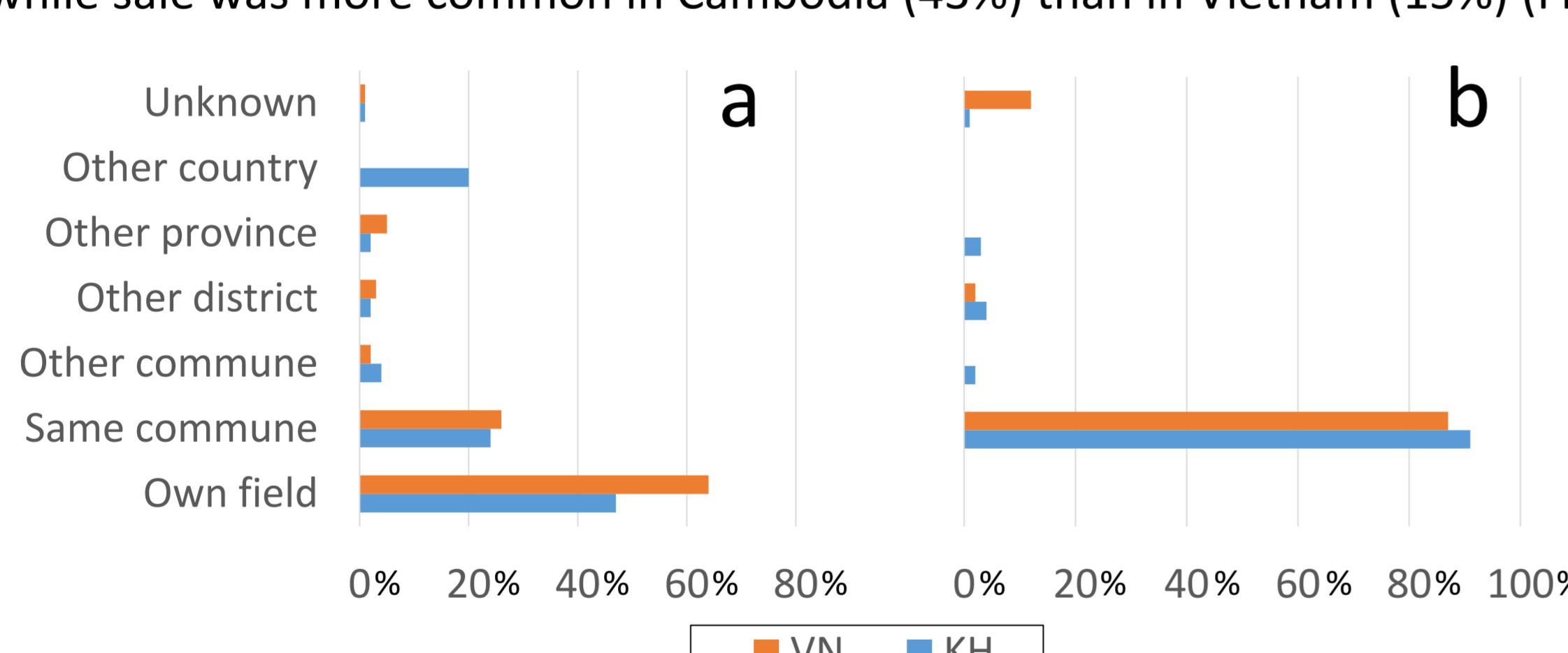


Figure 1. Geography of seed (a) acquisition and (b) provision to others in the 2016 field season, displayed in percentages of overall stake transactions recorded. VN = Vietnam, KH = Cambodia. Self-provisioning from the previous year is included.

The origin of internationally exchanged seeds was frequently not known to farmers beyond country level. Long-distance trade was most common in both Cambodia's Northeast and Western border provinces (Fig. 2), in which concentrated cassava production zones are complemented by high concentrations of starch factories in neighboring Thailand and Vietnam, respectively. This trade is likely facilitated by seasonal root transport vehicles operating between starch factories and supply areas (Fig. 4), providing back freight subsidizing seed movement, making provinces like Vietnam's Tay Ninh, with 41 starch factories, important stake export hubs.

Key conclusions

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- ✓ Re-use of farm-saved seed and community exchanges dominate the cassava seed system
- ✓ Long distance seed flows are sizeable and facilitated by trader networks
- ✓ 20% of Cambodia's seed acquisitions originated internationally (Vietnam, Thailand)
- ✓ Interventions to prevent the spread of seed-borne diseases should adopt tailored strategies for different actors (e.g. farmers vs. traders)

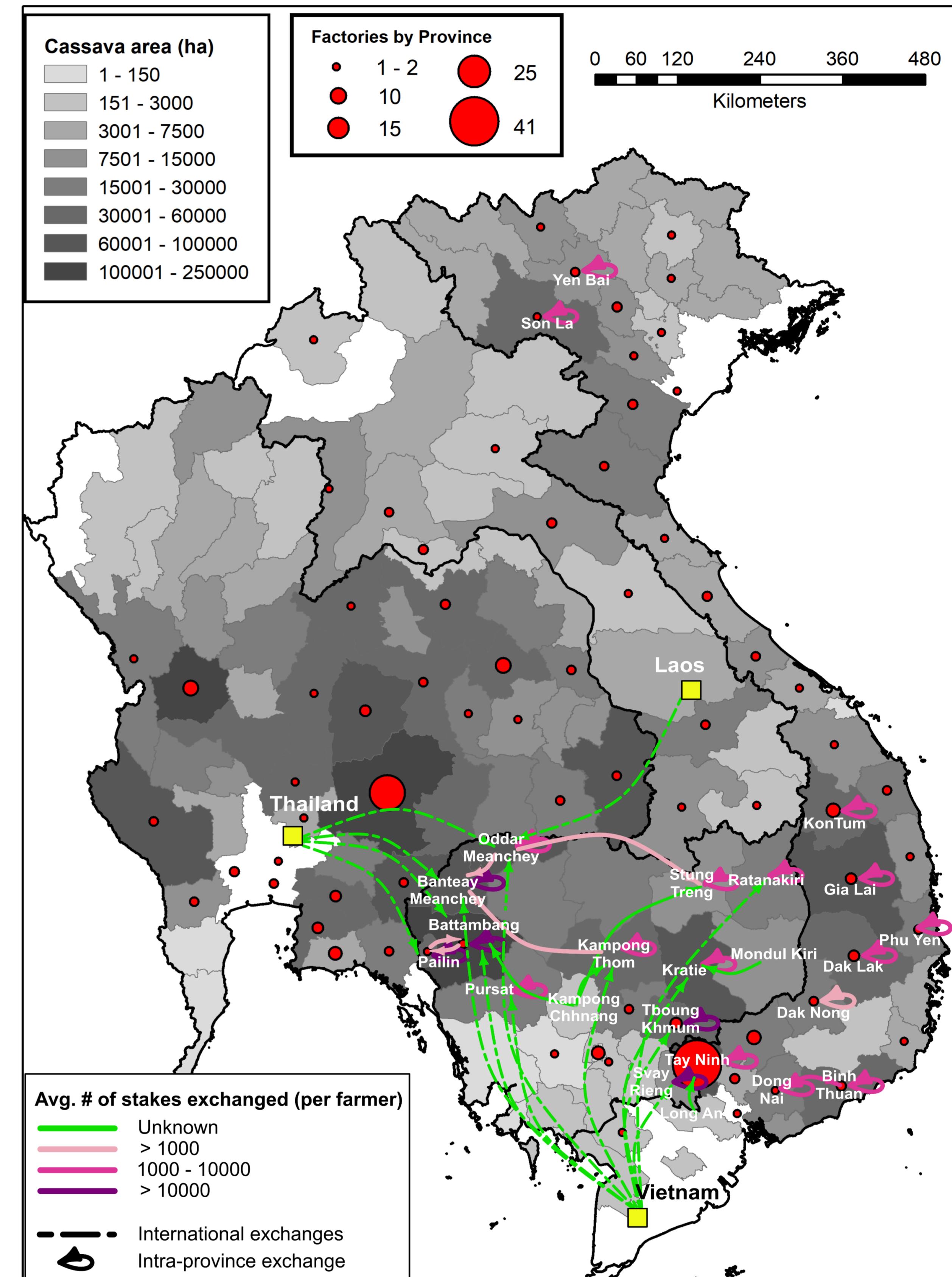


Figure 2. Network graph representing stake exchange per surveyed farmer (links) between provinces (nodes) in 2016, aggregated from national-level survey of farmers (n=240) in 16 districts in Cambodia, and 15 districts in Vietnam (n=206). Yellow square markers indicate exchanges for which seed origin/destination was only known to country level. Cassava area and number of cassava starch factories are indicated by province for 2016-17. Cassava area and starch factory data sources: Cambodia – Ministry of Agriculture, Vietnam – General Statistics Office, Thailand – National Statistics Office

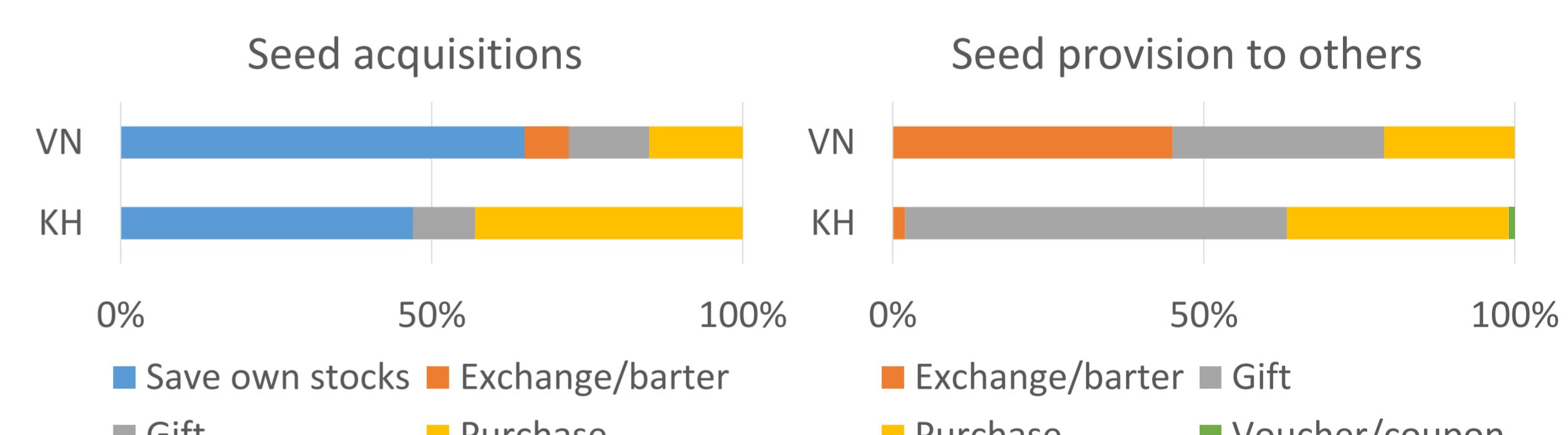


Figure 3. Methods of seed exchange reported in Cambodia (KH) and Vietnam (VN) in 2016, presented as percentages of total recorded seed exchanges



Figure 4. Bulk seed exchange in Eastern Cambodia (top) and Southern Vietnam (bottom).