CIMMYT Efforts on Integrated Straw in Nepal

Presented by
Gokul Paudel, Scott Justice, Andrew McDonald
International Maize and Wheat Improvement Center
Kathmandu Nepal

Regional Workshop of Integrated Straw Management in Asia and the Pacific
12-14 December 2017, Kathmandu, Nepal

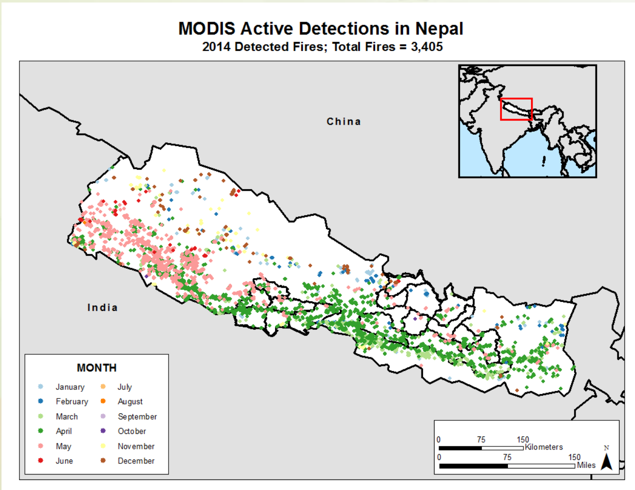
UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific
CSAM

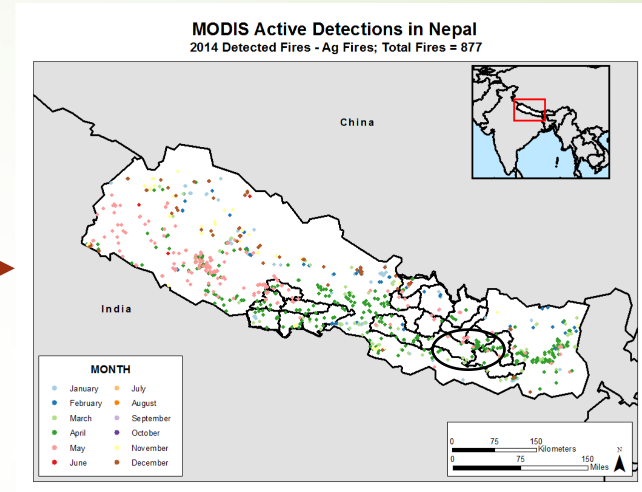
1. Introduction

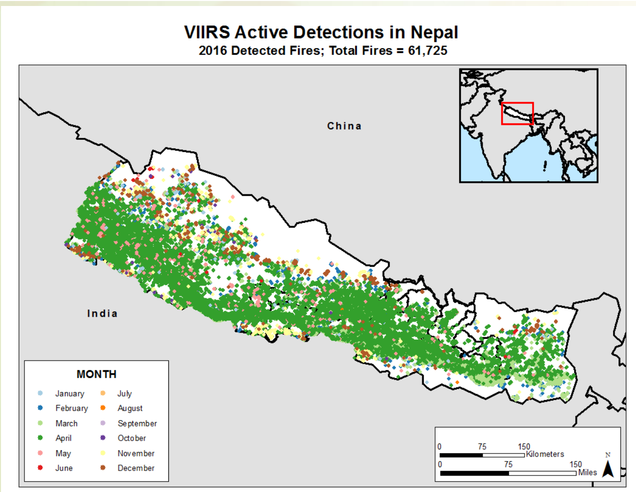
- CIMMYT is active in Nepal since mid-1980th from the time of rice-wheat consortium and the primary goal was to rapidly disseminate resource-conserving technologies (e.g., CA) in rice-wheat systems of IGB.
- Crop residue is one of most important tenant of CA among three (MT/ZT, CR (mulching) and crop rotation (legumes))
- CIMMYT is scaling CA based tenants for sustainable intensification (SI) of agricultural systems in South Asia (particularly in rice-wheat systems)
- In Nepal, CIMMYT's efforts are through several projects(eg., CSISA: USAID funded regional project in Nepal, India and Bangladesh), most recent CSISA-III operational in FTF ZOI (west, mid-west and far-west districts) and through partners (NARC)
- Agriculture mechanization is pivotal component in order to be success for SI based approach (e.g. seed drills)

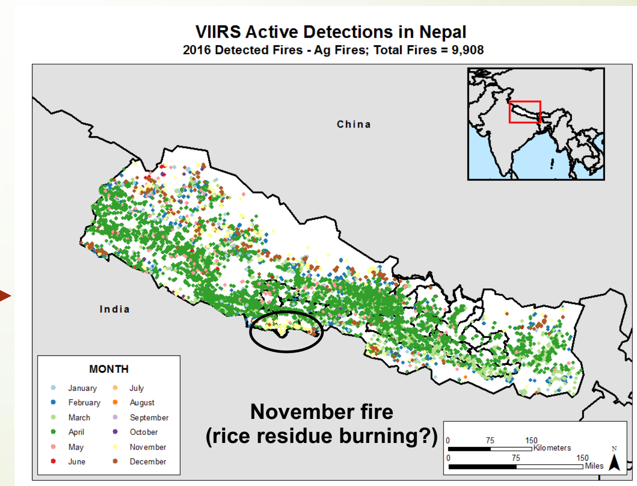
2. The broader picture: detecting fires on agricultural areas from RS

(Increasing fire incidents in agricultural land (potentially crop residue (CR) burning))



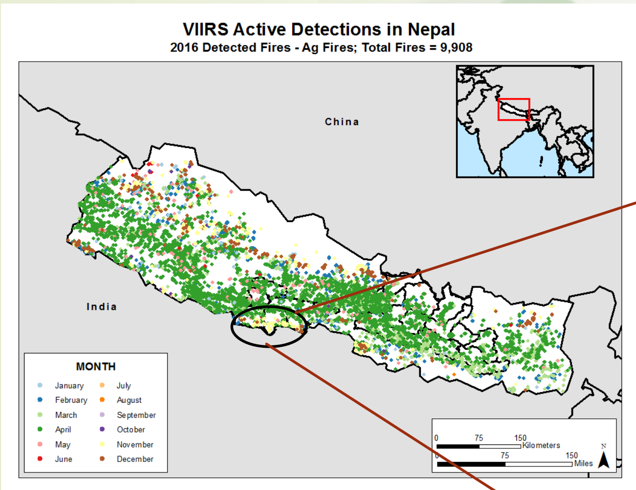


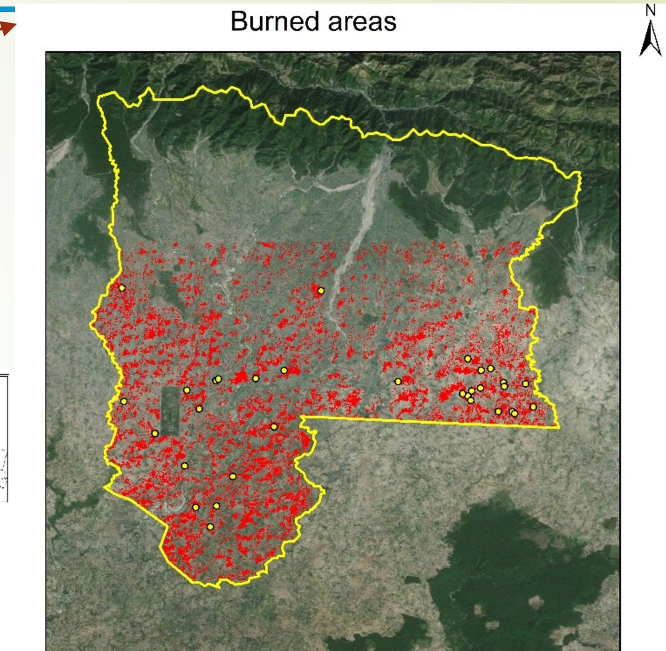




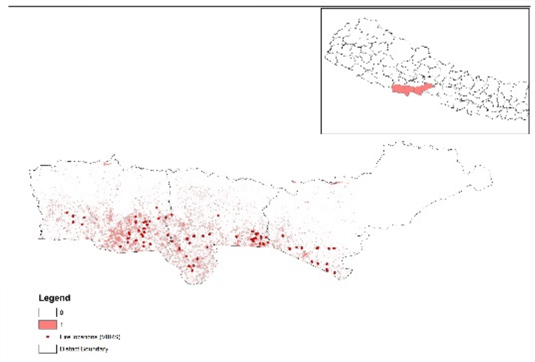
MODIS: Moderate Resolution Imaging Spectroradiometer
VIIRS: Visible Infrared Imaging Radiometer Suite
Map source: Jessica L. McCarty, Miami University, USA

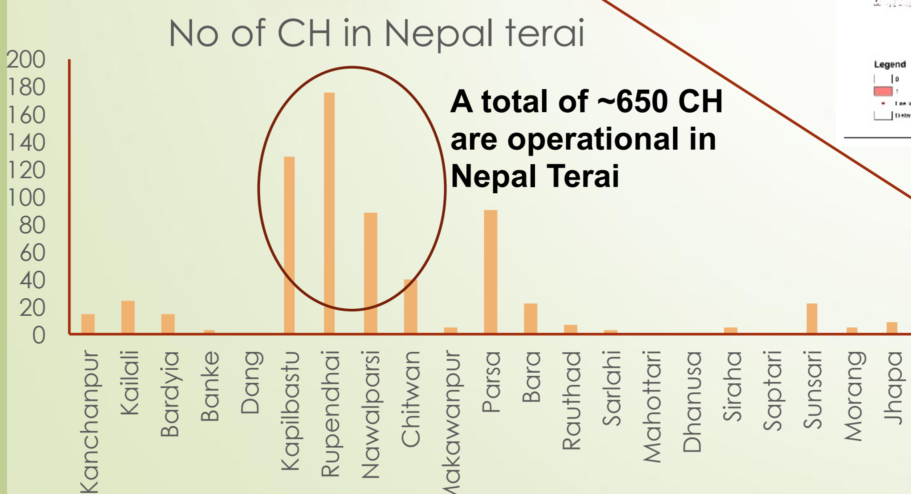
3. From coarse images to high resolution RS : (Sentinel-2) and verification from the field





The burned area in Rupendhai and its adjoin district matches with no of CH operational in districts





A total of ~650 CH are operational in Nepal Terai

CH data source: DADO's (Terai) 2016

4. Reasons for burning CR in Rupendhai, Kapilbastu and Nawalparsi, and losses of Nutrient (*thinking beyond environmental externalities*)

Reasons for CH harvested CR burning ?

	Rice (n=78)
Animal doesn't prefer CH harvested straw	25 (32)
Labor intensive process for collecting crop residue	12 (15)
Lower no of ruminant livestock holding	20 (25)
Low/no market value for crop residue	21 (27)

Note: Figures in parenthesis indicates the percentage

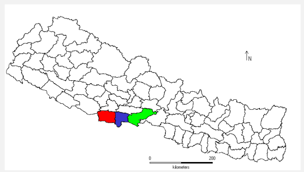
Who are the CH users?

	CH users (n=100)		CH non-users (n=30)		p value
	Mean	Std. error	Mean	Std. error	
Farm size (ha)	2.75	0.23	1.24	0.17	<0.01
Family size (no)	9.34	0.53	9.26	0.84	NS*
Large ruminants holding (no)	1.59	0.18	2.36	0.48	<0.07

***NS: Non significant**

Estimated losses of nutrients from CR burning in Rupendhai, Kapilbastu & Nawalparsi (Survey year 2015)

Nutrient	Rice				Wheat				Total nutrient loss in study districts (Mt)
	Conc. in straw (kg/Mt)	Loss in burn (%)	Loss (kg/ha)	Total loss (Mt)	Conc. in straw (kg/Mt)	Loss in burn (%)	Loss (kg/ha)	Total loss (Mt)	
C	400	100	1480	22206	400	100	1067	12913	35119
N	7.0	90	23.3	349	7.3	90	17.5	212	561
P	2.3	25	2.1	31	1.1	25	0.7	8.9	40
K	17.5	20	12.9	194	9.4	20	5.0	60	254
S	0.75	60	1.6	24	0.75	60	1.2	14	38



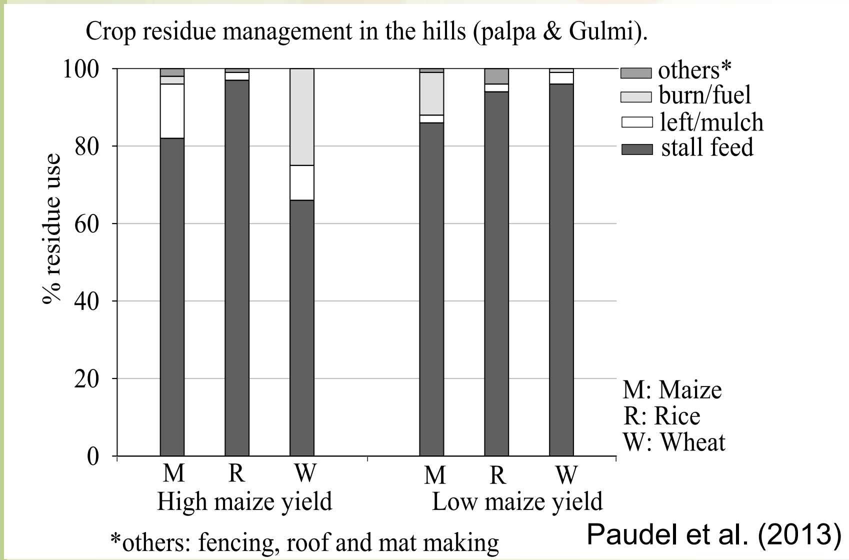
Total estimated area under burning of rice and wheat 30,126 ha

The nutrient composition of rice straw and percent loss in burning was calculated as per Dobermann and Fairhurst (2002) and wheat straw and percent loss was calculated by using Tarkalson et al., 2009. The rice and wheat straw productivity was assumed to be same with sample data for the entire areas. Burned residue was estimated using HI of 0.48 for rice (Fageria et al., 2011) and 0.50 for wheat (Hay, 1995 and Hay & Gilbert, 2001)

5. Spatial heterogeneity in CR use: CR in hills is critically important

- However, in this hills biomass is scare due to mixed crop livestock systems
- The lower productivity (crop yield and biomass) due to rainfed ecology
- The research carried out by CIMMYT-IFAD in 2013 indicates that majority of CR goes to the livestock feed and considerable dry fodder (CR) shortage exists in hills (particularly in dry periods)

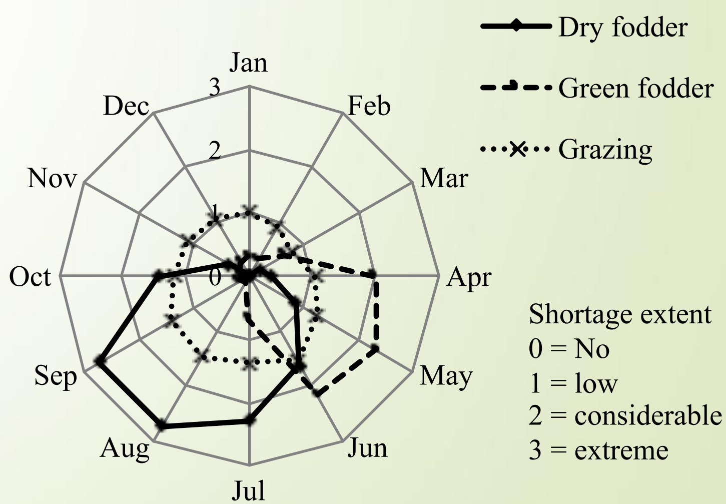
Hills (Rainfed): CR critically important (mixed system)



Stored for CR for lean period for livestock feed

Photo location: Gulmi

Extent of Feed Shortage in Hills (Palpa and Gulmi)



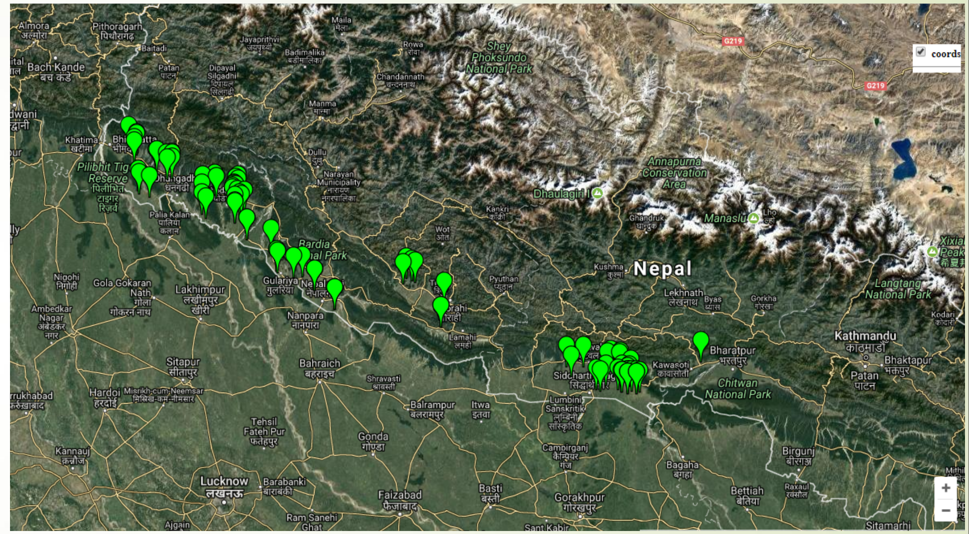
6. The necessity of CA (SI) for CR management and CIMMYT's efforts

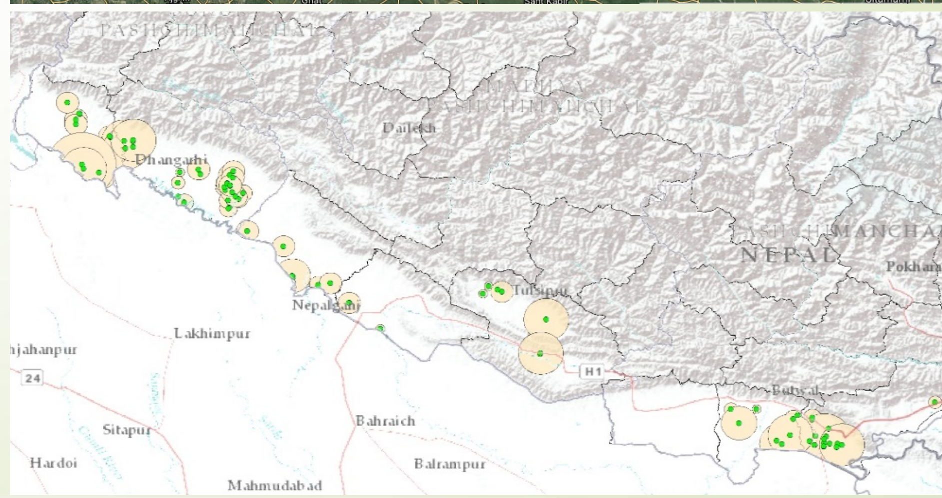
Developing service economy via Service Providers for ZT & DSR

CSISA's efforts has established 85 service providers (SP's) who owns 101 ZT seed drills and provided services to more than 565 farmers for ZT wheat and DSR (2017) in West, Mid-west and far west terai districts.

Over 600 ha of ZT wheat area is been provided by the service providers

Yet, adoption of such machineries is constrained by many socio-economic factors eg. small plots, easy availability of "*inferior*" technologies like "rotavator" and lack of awareness to the farmers and traditional concept "till more, grow more".





7. The introduction of Happy Seeder from CIMMYT (CSISA project) in western terai

Soil heath, -ve environmental externalities and sustainability of agricultural systems in terai region (higher scope for CA based interventions: CR burning)

Location: Rupendhai district

Fig 1: Use of Happy Seeder over left residue by Combiner

Fig 2: Line seeding of wheat done by happy seeder (the residue are chopped)

Fig 3: Germination of wheat after use of Happy Seeder

This machine is expensive and how to promote attraction of SP's on this machine? Need to test a different types of business model e.g. *"linking SP with cheap credit"*. *Subsidy approach may not be sustainable one.*

UNITED NATIONS ESCAP CSAM

8. ZT Seed drills: perfect machine for partial residue retention, yet some problems in full CR retention

Location: Far-west and western terai

Fig 1: ZT-wheat under partial residue retention

Fig 2: ZT-wheat under partial CR retention

Fig 3: ZT-wheat under partial CR retention

- Significant yield advantage and cost saving have been reported from the ZT-wheat while significant cost saving from DSR has been documented from IGB
- Yet adoption of ZT is hindered by easy availability of "rotavators" and other traditional "tillage options"

UNITED NATIONS ESCAP Economic and Social Commission for Asia and the Pacific CSAM

9. Baler for residue management

Shaktiman's (India's comapy) "small" round baler being demonstrated by NARC and DOA in Bara District, Nepal. Uses twine / string for wrapping. Bale is 2 feet by 2 feet approx 50 pounds (24 kgs) and approx 50 bales / hour.

10. Bhusa collector after combiner

Farmers in Kapilbsatu are also using these collector particular for wheat but not for rice (most familiar technology in North west India for wheat residue collection)

ESCAP CSAM

11. A residue compactor and CR trade

Location: Bihar, Nalada

11. A trade of CR (from Bhairahwa to Chitwan)

Location: Captured in Daunne, Nawalparsi (hight)

12. Conclusion

- Policies should signal and persuade farmers and service providers to move towards more sustainable technology options (e.g. ZT) and away from others (rotary tillage) in order to maintain the soil health and minimize the –ve externalities from agriculture (e.g. residue burning)

- The GoN promulgated farm mechanization policy in 2014 and several promotion policy were formulated which includes subsidy in mechanization and such encouragement should include the sustainable intensifications based technologies through the channel of service providers

- Energy policy: Incentives to the farmers to minimize the residue burning problem could also be an alternative option (one study has been done in Nepal in 2012)