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USAID Agricultural Index Insurance in Nepal

Phase 1 Final Report

This report closes the first phase of the feasibility study of Index Insurance for agriculture in Nepal prepared by I4/BASIS for USAID. This first phase was dedicated to the identification of the areas and crops where the development impacts of index insurance would be maximized and where index insurance might be an appropriate solution to the risks farmers face. The conclusion of this first stage is that rice appears to be the best candidate, combining potentially high development impacts and existing technological solutions for the development of an index. The I4/BASIS team will keep working on other crops (maize and/or lentils) in case rice would appear to be a wrong choice, or if the project was expanded to a second crop. These conclusions are the result of an analysis of

1 – The requirements for the development of index insurance

2 – The economic viability of an insurance product

3 – The regulatory environment in Nepal

4 – The existing agricultural insurance products available in Nepal

5 – The credit conditions specific to each kind of farmers in Nepal

6 – The combination of potential development impacts and the existence of an appropriate technology for the computation of an index.

These six dimensions of our analysis are detailed below.

1. Requirements for the development of an Index Insurance product

When *conventional* agricultural insurance is too expensive because the cost of visiting farms (for loss assessment) is too high compared to the value of the production/goods insured, recent developments in

agricultural insurance emphasize the possibility to implement agricultural *index* insurance. Index insurance has been developed to offer farmers a less expensive alternative to *conventional* insurance. Instead of asking farmers to fill claims and send experts to the field to verify these claims, index insurance uses an *index* to estimate losses, and indemnities are automatically paid to farmers if this index passes a pre-defined threshold. Farmers don't need to fill claims and the insurance company does not need to send an expert to the field. Of course, the closer this index is to actual yield the better, as long as the farmer cannot manipulate the index to make it trigger artificially. There exist three kinds of indices that have been used for index insurance purpose so far:

- Area yield index: The area yield index is simply the average yield over a defined area (small enough to match farmers actual losses, but large enough to prevent manipulation by farmers). This type of index is the best available because it directly *measures* (versus *predicts*) production conditions in the area and captures any kind of disaster that could happen (flood, drought, diseases, etc.). The difficulty however is often to get long historical data as well as real time data delivery at the appropriate scale. In Nepal, the conditions for the use of such index are not fulfilled:
    - The only source providing regular yield data for a majority of commodities is the Ministry of Agricultural Development's Yearbooks. Unfortunately, these data are only available at the district level, which is too large for index insurance purpose. Given the great variability of climate conditions within districts, an index based on such data would not cover farmers against a significant part of the risk.
    - Other possible sources of yield data include cooperatives and collection centers, but these commodities are often (at least partially) food crops, which makes accounting difficult, and there often exist several possible buyers outside of the cooperative or collective center, so that a drop in the number recorded by the cooperative can be the sign of low yield or of more profitable market opportunities outside the cooperative.
    - Other important characteristics that yield data must have for index insurance are *long history*, so that we can price the risk of low yields, and *availability in near real time*. These are conditions that neither the Yearbooks nor the cooperative data can fulfill.

- Weather Index: When Area-yield index insurance is not possible, then we have to look for second best options. One of them is to rely on weather data (rainfall, temperature, wind speed, etc.). Indeed, weather events are often the cause of yield losses (together with diseases, pest, and insects) and can easily be measured at weather stations or remotely sensed by satellite. The

challenge in the case of Nepal is again its terrain: while weather stations might give a reasonable estimate of weather conditions in the Terai (flat area), it is likely that weather stations won't be able to accurately predict conditions in the hills or the mountainous areas.

- The World Bank's feasibility study for agricultural insurance in Nepal (2009) performed a correlation analysis of district level yield and annual rainfall records between 1994 and 2007. Their results (table 1) show that despite its importance in agricultural production, rainfall can only predict a small share of yield variability, suggesting that other (better) indices are required. This result is in line with many studies for other countries which show that rainfall indices are often bad predictors of yield and that rainfall stations can only accurately predict rainfall over a 4-5km radius around the station.
- The combination of weather station data and remotely sensed weather data can partially solve this issue by filling the gaps between weather stations, but some important threats to crop production would still not be captured (diseases, pest, insects, etc.).
- More recent approaches propose to combine several weather indices into crop growth models (like ORYZA2000 for rice) allowing for more sophisticated relationship between yield and weather; these models are further discussed later in this report.

Table 1 - Correlation between District-level Paddy Yields and Rainfall 1994/95 to 2006/07 (R-squared values)

Station	Annual Rainfall	Monsoon Rainfall (June-Oct)
Dadeldhura	0.0193	0.0235
Jumla	0.089	0.0056
Banke	0.2557	0.2858
Kaski	0.0313	0.0337
Sindhuli	0.7067	0.7194
Chitwan	0.2237	0.1019
Dhankuta	0.1479	0.2155
Siraha	0.0166	0.0219
Morang	0.1954	0.104

Source: World Bank, 2009, Agricultural Insurance Feasibility Study for Nepal

- Vegetation Index: The last and most recent kind of index is based on vegetation indices. These indices measure some dimensions of plants' health using remote sensing techniques. A popular example is the NDVI (Normalized Difference Vegetation Index) that has been used in Africa for the IBLI (Index-based Livestock Insurance) project. NDVI measures the amount of light that is being absorbed or reflected. Each plant has its own "signature", so that NDVI can be used to (i) isolate cropping areas from other types of coverage (forest, cities, water, etc.) and (ii) measure deviations from normal years which correspond to crop losses. Other vegetation indices (Leaf

Area Index, Evapotranspiration, etc.) provide other indicators of plant's health; which is the best one remains an open question, and I4/BASIS is currently working to answer it. Given the lack of historical yield data and the poor performance of weather based indices, we believe that this kind of index is probably the best option for Nepal. However, it is not without challenges: most of the indices available (NDVI, ET, LAI, etc.) are based on *optical* sensors, meaning that if the area is cloudy for an extended period of time, the satellite will not be able to take useful pictures and the index cannot be calculated. Other options like *radar* sensors might be a better alternative in this case. We discuss these technological alternatives a little bit further later in this document.

2. The economic viability of an insurance product

While index insurance can be an affordable alternative to conventional insurance, it remains a market-based instrument, and so requires a market large enough to be economically viable for the insurance company. This minimal market size is important for two reasons. First, the insurance company wants to engage in a profitable activity and the existence of administrative fixed costs makes it possible only if the value at risk is large enough (i.e., premiums collected can actually cover these costs). Second, the insurance company can efficiently handle risk only if the risk is diverse enough within its portfolio so that it can indemnify a farmer A using premiums paid by a farmer B. If farmers A and B always experience shocks at the same time, the risk of having of a negative balance for the insurance company is greater. The insurance company's loss ratio (indemnities paid / premium collected) becomes very volatile while the insurance company wants it to be stable over time.

Table 2 – Most important agricultural commodities by area cultivated (2013)

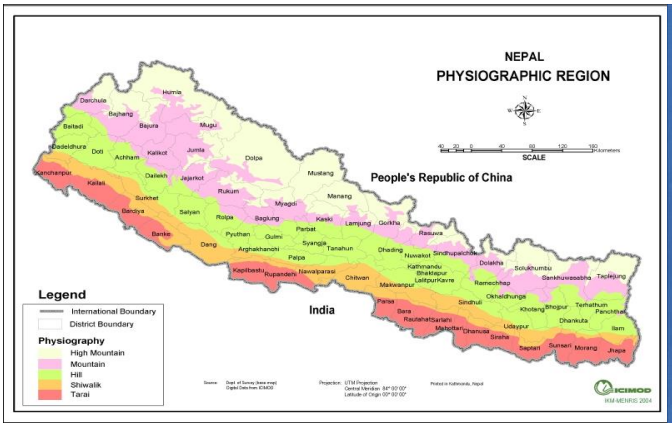
Commodity	Area (Ha)	Percentage	Cumulative percentage
Paddy	1420570	32.07%	32.07%
Maize	849635	19.18%	51.25%
Wheat	759843	17.15%	68.40%
Millet	274350	6.19%	74.59%
Vegetables	246392	5.56%	80.15%
Oilseed	215600	4.87%	85.02%
Lentil	206512	4.66%	89.68%
Potato	197234	4.45%	94.13%
Sugarcane	64483	1.46%	95.59%

Source: Statistical Information on Nepalese Agriculture, 2013

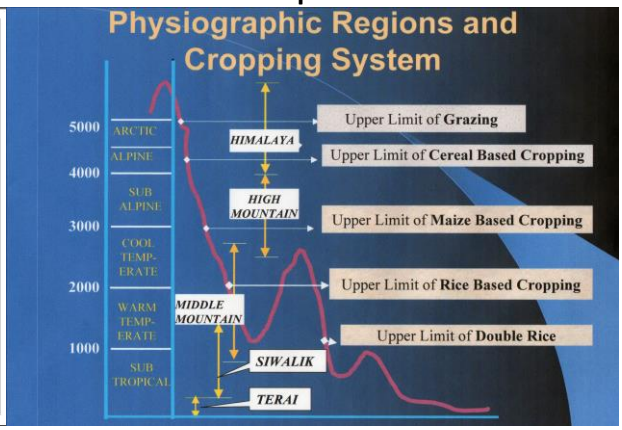
Table 2 shows areas cultivated for the most important agricultural commodities in Nepal. It appears that about 68% of cultivated land is concentrated on 3 main crops (paddy, maize, and wheat). A second group of commodities would include millet, vegetables, oilseed, lentil, potato and sugarcane. Other commodities represent smaller shares of total cultivated area, meaning that the insurance market for such commodities would be extremely thin, questioning the economic viability of an insurance product developed for these commodities.

Map 1 – USAID's target districts in Nepal

Map 2a – Geography of Nepal



Map 2b – Terrain and Cropping systems in Nepal



Given USAID's target areas in Nepal (Map 1), and Nepal's geography (Maps 2a and 2b), we focus our efforts on the Western part of the country, in the Terai and the Hills. Table 3 below details the cropping areas for each ecological region in Nepal (Terai, Hills and Mountains), and shows that the most important crops in this region in terms of cultivated area are, by order of importance, Paddy, Maize and Wheat.

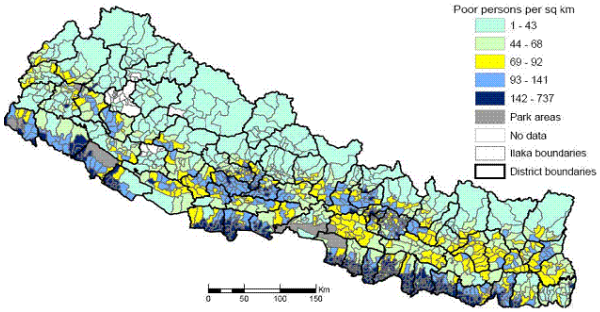
Table 3 – 2006/07 Cropped Area by Ecological Region

Crop	Mountain	% of Total	Hill	% of Total	Terai	% of Total	Total Nepal
Paddy	62,263	4%	367,710	26%	1,009,552	70%	1,439,525
Maize	88,288	10%	613,774	71%	168,339	19%	870,401
Millet	53,174	20%	200,186	75%	11,800	4%	265,160
Wheat	53,173	8%	246,223	35%	403,268	57%	702,664
Barley	12,026	45%	13,576	51%	978	4%	26,580
Oil Seed	4,450	2%	38,402	21%	141,366	77%	184,218
Potato	25,825	17%	66,658	43%	61,051	40%	153,534
Tobacco	0	0%	14	1%	2,715	99%	2,729
Sugar Cane	294	0%	1,070	2%	62,655	98%	64,019
Total	**299,493**	**8%**	**1,547,613**	**42%**	**1,861,724**	**50%**	**3,708,830**

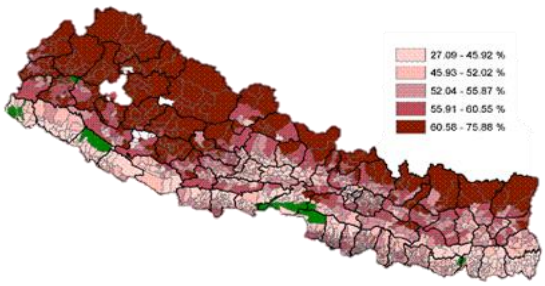
Considering the density of poverty by Ilaka in Map 3 below, it appears that poverty is concentrated in the Terai. However, maps of malnutrition (Map 4) indicate that food insecurity is more prevalent in the Hills and Mountainous areas. Two options appear in this case:

- We can focus our efforts in the Hills region in order to develop production in this area and reduce malnutrition.
- Or we can focus our efforts in the Terai, which is the main production area in Nepal, in order to increase existing food surpluses in this area. These food surpluses can then help reduce malnutrition in the Hills.

Map 3 – Poverty density in Nepal



Map 4 - Prevalence of stunting in Nepal



Agricultural insurance can only be part of the solution to this issue, and it can only be an appropriate solution if some conditions are fulfilled. These conditions are

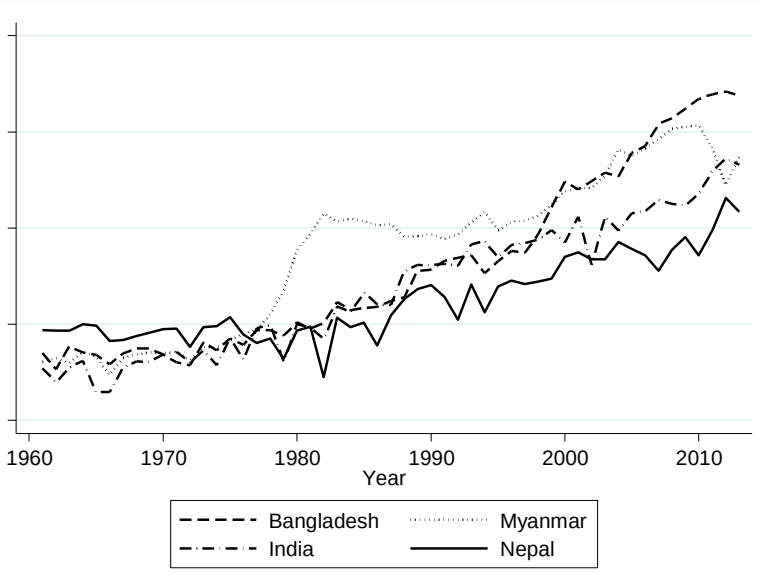
- The existence of insurable risk in the commodity/area considered
- Evidence that risk is actually a barrier to the development of this production activity
- The existence of datasets that will allow us to measure and price risk.

These three dimensions are developed further later in this document for each commodity under consideration.

When developing an insurance product, it is also important to consider the market structure of the commodity. There is indeed a tradeoff between staple crops, cash crops and livestock.

- Focusing the effort on staple crops can be an appropriate strategy if (i) we want to reach a maximum number of households, and (ii) we believe that risk is a limiting factor for the development of investments in this activity. In the worst-case scenario, risk can create a dependence *vis-à-vis*its commercial partners (i.e. the country imports its main staple crop). When the commercial partner imposes an export ban (like India did for rice between 2007 and 2011), the importing country can see the price of the staple crop increase and serious food security issues can appear.

Graph 1 –Paddy rice yields (Hg/Ha)



In Nepal, the main staple crop is rice. Comparing historical rice yield data for Nepal and its neighboring countries (Graph 1), we observe that while Nepal does have the lowest yield in the region, the gap with India (90% of rice imports come from India) is relatively modest compared with other countries (Bangladesh and China have much higher yields) and is stable over time indicating that Nepal is not necessarily unable to catch up with India, it simply started to transition toward higher yields later than India (about ten years later). In this case, Nepal appears to be able to develop its rice production and gain its food independence from India.
The transition to higher yield production methods might soon be necessary for Nepal as rice deficits in Nepal are projected to grow in the coming decades (Table 4). It is important to find ways to stimulate rice production in Nepal. This additional production would likely be fully absorbed by the local market. If Nepal becomes able to produce rice surpluses, these surpluses could be absorbed by the Chinese market, which is already importing large quantities of rice from Nepal (table or graph).

Table 4 – Projected Demand, Supply, Deficit and Surplus for Rice in Nepal

Crop	Year	Supply (thousands of tons)		Total demand (thousands of tons)		Deficit (-) / surplus (+) (%)**		Direct demand (thousands of tons)		Deficit (-) / surplus (+) (%)**	
		PS	OS	PS	OS	PS	OS	PS	OS	PS	OS
Rice*	2010	2,691	2,712	3,851	3,846	-43.1	-41.8	3,244	3,240	-20.6	-19.5
	2015	2,645	2,838	4,276	4,267	-61.7	-50.4	3,602	3,594	-36.2	-26.7
	2020	2,600	3,238	4,671	4,778	-79.7	-47.6	3,935	4,025	-51.3	-24.3
	2025	2,556	3,653	5,002	5,245	-95.7	-43.6	4,214	4,419	-64.9	-20.9
	2030	2,512	4,085	5,364	5,764	-113.5	-41.1	4,518	4,856	-79.9	-18.9

Source: IFPRI, 2011, "Supply and Demand for Cereals in Nepal, 2010–2030"
*Notes: *Supply of rice has been converted to rice equivalent using a factor of 0.63; ** deficit or surplus as a percentage of supply (domestic production); PS, Pessimistic scenario; OS, Optimistic scenario*

The second most important staple crop in Nepal is Maize. Maize is grown as a primary crop in the hills and as a winter crop in the Terai (after rice has been harvested). Here also, India is the main commercial partner for Nepal who imports large quantities of maize every year, but India and Nepal share very similar yield levels (Graph 2).

- The second option is to devote our efforts to important cash crops which give farmers the income necessary to purchase staple crops (possibly produced abroad). Incentivizing farmers to produce cash crops instead of staple crops is an appropriate strategy in terms of natural resources use efficiency. If we believe that Nepal cannot keep competing with its neighbors' on the rice market,

it might be better to invest in commodities in which Nepal has comparative advantages, and then trade these cash crops for staple crops on international markets. Again, this strategy must be applied with great precautions, since it makes the country dependent from its commercial partner for its food security. Recent experience on the international market for rice (price spikes, followed - and caused by - exports bans) shows that even large exporting countries can decide to limit their exports in order to protect their population against high food prices, creating even stronger pressures on the international market, and importing countries turn out to be the most impacted by the crisis.

Table 5 – Production and Exports of lentils in Nepal

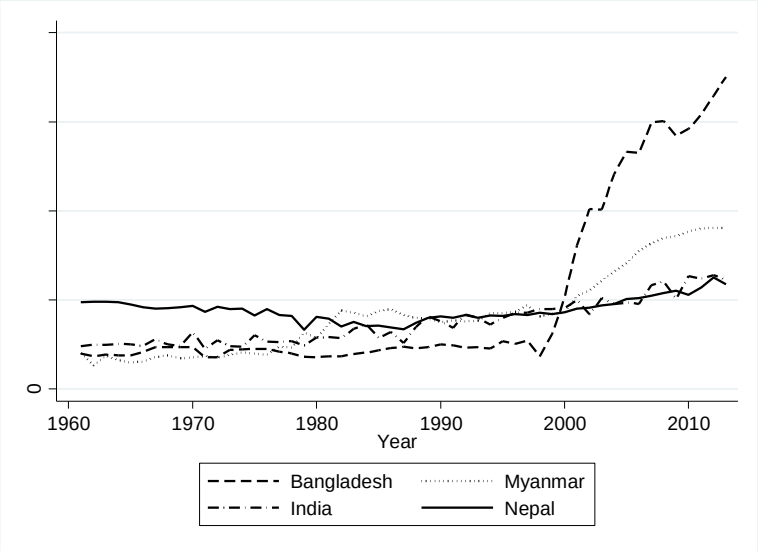
	Production			**Exports**			**Exported share of total production** (%)
	Quantity ('000 MT)	Area (Ha)	Yield (MT/Ha)	Quantity (MT)	Value ('000 US$)	Unit value US$/MT	
2000/01	143	178.7	0.8	15,094	6,810	451	10.56%
2001/02	148.3	180.2	0.82	22,785	6,022	264	15.36%
2002/03	149.9	183.2	0.82	30,449	12,877	423	20.31%
2003/04	158.6	187.7	0.84	15,252	6,992	458	9.62%
2004/05	160.7	188.8	0.85	14,591	7,273	498	9.08%
2005/06	157.9	183.1	0.86	7,778	4,670	600	4.93%
2006/07	164.6	189.1	0.87	4,109	3,129	761	2.50%
2007/08	161.1	169.4	0.85	16,417	22,075	1,345	10.19%
2008/09	147.7	183.7	0.8	56,768	73,115	1,288	38.43%
2009/10	151.7	187.5	0.81	37,560	51,244	1,364	24.76%

Source: USAID Nepal, 2011, "Value chain/market analysis of the lentil sub-sector in Nepal

In the case of Nepal, the best cash crop candidate is lentil. Lentil is the most important export crop in Nepal, representing about half the value of rice imports. However, only 600,000 Nepalese farmers (2.5% of total population) grow lentil and the majority of them cultivate this pulse crop on plots of about 0.2 hectares. Such small lentil plots, unless consistently clustered all together (which does not seem to be the case in Nepal) would make the use of remote sensing methods very difficult. The only possible kind of index available for lentils would then be an *area yield index*, but Nepal only exports about 10% (fluctuating between 2% and 40%, see table 5) of its lentil production, which greatly reduces the possibility to accurately measure yield based on records throughout the value chain. Combined with the somehow limited development impacts

we can expect from lentil because of the small share of the population involved, these difficulties to accurately measure or predict yields in the lentil sector makes it a difficult candidate for the development of index insurance in this project.

Graph 2 –Maize yields (Hg/Ha)



Another cash commodity that has great potential for the development of farmers' incomes in Nepal is vegetables. USAID's actions through the KISAN project in this direction offer an interesting base for the development of other interventions like index insurance. Vegetable cultivation in Nepal (primarily in the hills) is developed around collection centers that could be the base for index calculations. The possibility of agricultural insurance for vegetables in Nepal is further studied later in this report.

Table 6 - Average livestock ownership (number) per household by eco-zone

Species	Mountains	Hills	Terai
Cattle	6.2	4.2-3.18	7.1-4.63
Buffalo	0.6	1.8-2.01	2.0-3.21
Equines	0.9	0.06	0.02
Sheep	3.2	0.4-0.13	0.3-0.29
Goats	3.4	2.1-3.53	1.3-3.08
Sub-Total	14.3	8.56	10.72
Pigs	0.4	0.1-0.25	0.2-0.15
Chickens	2.2	3.1	3
Ducks	0.02	0.07	0.1
Work Oxen	2.2	2.4	3.2
Buffalo bullocks for work	0	0	0.5

Source: Livestock Master Plan, 1993; volume III; page 222

- The third kind of agricultural commodity that could benefit from agricultural insurance is livestock, which always plays a particular role in farmers' life. Indeed, livestock can be considered as a mean of production (cattle helping for ploughing activities), a product itself (meat and milk), and as a way to accumulate savings. There is an enormous livestock population which puts considerable pressure on land resources. In 2004, Nepal could count 6.9 million cattle (including yaks and hybrids), 3.9 million buffalos, 0.82 million sheep and 6.9 million goats. The ruminant population is greatest in the Hills, followed by the Terai and is least in the Mountains. However, average numbers of livestock per household are generally higher in Mountain households than Terai or Hill households (Table 6). Terai households generally have more cattle to produce draught bullocks because their holdings are larger (2.58 ha.) than in the Hills (1.01 ha.) or Mountains (0.83 ha.). Buffaloes are used for cultivation in the Terai (Table 5).

In this setting, following experts' advice in Nepal, and considering the technical and data limitations, we focus our efforts in Stage 1 on paddy, maize, vegetables, and livestock. Paddy and maize are two key cereal crops in Nepalese diet, and are two crops that suffer a lot from climatic events (delayed monsoon and changes in monsoon intensity for rice; cold temperatures for maize), while vegetable production is an important source of cash for farmers; livestock is often a way to accumulate assets for farmers so that losing a cow is a dramatic event for an agricultural household. Agricultural insurance against such events often has a high value for farmers. However, as will be detailed later in this document, the need for index insurance for these two latter commodities is not obvious, because (i) covariate shocks that can be insured using index insurance might not be a concern for vegetables and livestock and (ii) existing programs seem to offer farmers appropriate coverage. We give a brief overview of the regulatory framework and existing insurance schemes in Nepal in the following sections.

3. Regulatory Environment

In January 2013, The Government of Nepal (through the Insurance Board) introduced crop and livestock insurance directives to encourage insurance companies to develop *commercial* agricultural insurance. The objective is to offer farmers and investors in the agricultural sector the tools to reduce the risks associated with loss/damage resulting from situations beyond control- (flood, landslide, drought, excess rainfall, hailstones, snowfall, frost, diseases/pests, earthquake, etc.).

a. Obligation to offer agricultural insurance

The directive introduces the obligation for non-life insurance companies to offer agricultural insurance but the authorities have not aggressively enforced this obligation in order to let insurance companies

adapt and learn. The directive also offers guidelines for the insurance policies that insurance companies can use. Insurance companies are also free to submit their own schemes for approval by the Insurance Board.

b. The Subsidy scheme

The Ministry of Agricultural Development introduced a subsidy on the premium paid for insurance of crop and livestock in June 2013. The government provides a 50 percent subsidy on insurance premiums paid by individual farmers, farmers' groups and farmer cooperatives. The maximum value at risk for this subsidy program is Rs. 10 million (USD 100,000). This subsidy scheme is scheduled to stop after 5 years; insurance policies will have to reach sustainability by that time.

In this fiscal year (2013/14), only Rs.135 million of subsidies on insurance premium have been allocated, corresponding to less than 20% of the budgeted amount (USD 1.3 million). In response to this low disbursement level, the subsidy will be increased to 75% next fiscal year and the overall budget will be cut in half (to USD 650,000).

Indeed, while 17 out of 19 non-life insurance companies have offered agricultural insurance this year, they typically only offer coverage for livestock producers, but do not offer coverage for cereal crops, fruits or vegetables. According to Beema Samiti, the insurance regulatory board, the absence of agricultural insurance products in Nepal is mostly due to the lack of knowledge about agricultural risks, not a lack of profitability. Beema Samiti issued the directive on agricultural insurance to help insurance companies and share its knowledge with them. This directive is not trying to force insurance companies to apply the policies developed by Beema Samiti, but is instead intended to provide guidelines for the development of new agricultural insurance products by insurance companies themselves.

c. Non-regulated Insurance

Other entities are allowed to offer insurance-like products to farmers. Because they are not insurance companies, they do not have to comply with rules that apply to insurance companies (licensing by the Insurance Board, minimum capital, solvency requirements, etc.). These programs, led by the Credit and Deposit Guarantee Corporation and the Agricultural Development Bank (Public owned financial institutions), also benefit from a 50% subsidy from the government. This subsidy program is separate from the insurance companies' subsidy scheme and is not scheduled to stop anytime soon. We discuss these programs further later in the next section.

4. **Agricultural Insurance Products in Nepal**

a. Regulated sector (Insurance Companies)

Supply side: Agricultural Insurance is a very new activity for private insurance companies in Nepal. Indeed, before 2013, insurance companies were not involved in this sector. Because it is a new activity for them and they lack expertise in agricultural risk management, insurance companies often only offer livestock insurance. Indeed Nepal has a long history of non-regulated livestock insurance schemes so that the risks are well-known. Also, livestock is often seen as more valuable and easier to monitor than crops. An initial visit by a veterinary to verify the animal's health, and a follow-up if the farmer fills an indemnity claim is enough to verify if indemnities are due or not. In the case of crops, it is harder to determine that losses are due to factors outside of the farmer's control and that the farmer did his best to get a good harvest (with use of quality inputs like seeds and appropriate timing of planting, etc.), so that insurance companies have difficulties evaluating the risk attached to crop production. Programs of training of trainers are being implemented by the Ministry of Agricultural Development and the Insurance Board to solve this issue.

Demand side: farmers are often not aware of the government scheme for crops and livestock, and the scheme proposed by the government might seem overwhelmingly complicated to Nepalese farmers. Also, Nepalese farmers (mostly livestock farmers) already benefit from other insurance schemes that are highly subsidized by the government, so that private insurance companies cannot offer a comparable value-for-money.

b. Non-Regulated Sector

Deposit and Credit Guarantee Corporation (DCGC)

The DCGC is a public institution held by the Government (90%) and the Central Bank (10%). Its primary role is to insure credits and deposits for banks and other financial institutions. Its role in the agricultural sector is mainly to cover loans, but it can also insure individual livestock farmers directly if they own more than 10 cows.

Credit guarantee cover: This insurance product covers loans, not the value of the animal. When the loan is repaid, the insurance contract stops. The animal must be inspected by a veterinarian and a health certificate is issued. The animal must also be ear tagged. The policy indemnifies the insured livestock owner against (i) the death of the insured animal or (ii) *loss of use* of the animal (determined by an authorized technician). The compensation levels are:

- 80% of the sum insured in the event of death of the animal.
- 40% of the sum insured in the event of loss of use.

The premium is set at 8% of the value at risk (3% paid by the farmer and 5% paid by the Government). The high cost of administration of the scheme (the need for expert assessments at each step) generates a negative balance for this program.

DCGC does not offer crop insurance, considering it too risky because of input supply issues and weather variability.

DCGC's main activity is to offer coverage for the financial sector (MFIs). MFIs often offer non-collateralized loans to farmers but rely on group mutual insurance to reduce risk. When a farmer is unable to repay his loan, other group members repay the farmer's loan to the MFI on behalf of the farmer in order to prevent default. Hence DCGC offers MFIs portfolio insurance for a very low premium set at 1% (0.5% paid by the MFI and 0.5% paid by the government).

Agricultural Development Bank / Sana Kisan Bikas Bank (Small Farmer Cooperative model)

This program is managed by farmers' cooperatives. Farmers are organized in groups:

- Small Farmer Groups (SFG): Representatives of Small Farmer members (5-12 members) form a SFG at the grass-roots level. The SFGs decide on collection of savings, loans and community development programs in the village.
- Inter-Group (IG): Two or more SFGs form an IG at the ward level. The IG supervises, coordinates activities of SFGs.
- Main Committee (MC)-a Board of Directors (BoDs) of SFCLs: All IG Chairpersons from each IG form the BoDs at the VDC level. The BoD as a governing body of SFCLs, formulates plans, policies and appoints staff to carry out activities. The BOD is accountable to the General Assembly (GA).

The Sana Kisan Bank and the Agricultural Development Bank provide credit to small farmers (through the cooperatives) but also manage the *Cattle Security Program*. This insurance program is restricted to farmers who are part of a SFG. An insurance committee is formed inside each VDC. This insurance committee is in charge of claim verification. A similar program is now also available to vegetable farmers through the Agricultural Development Bank.

Insured farmers must be members of a group and they pool the premiums collected on a group account. In the case of livestock, premiums are set at 10% (5% paid by the farmer, 5% paid by the government); in the case of vegetables, the premium is set at 15% (7.5% paid by the farmer, and 7.5% paid by the government). Indemnities cover 80% of the value at risk. However, because indemnities are paid by the premiums collected inside the group, if all the farmers inside one group experience a shock altogether (epidemic disease or hail storm), they will split their indemnities, reducing the coverage level and the value of this insurance scheme for farmers. Further, when no catastrophe happens, the premiums paid by the farmers are transferred to a saving account so that the group can decide to reinvest it next year in insurance or any other asset.

Figure 1 – Organization of the Small Farmer Cooperative Model

Source: Sana Kisan Bikas Bank website

Hence, the program strongly depends on public funds and might bias farmers' perception of the cost of risk. However, historical data on the livestock component of the program show that indemnity claims are so rare that that the program is still profitable for the bank even if it does not accumulate farmers' contributions.

The existence of the livestock insurance program implemented by the Agricultural Development Bank makes it very unlikely that "true" (maybe unsubsidized) insurance product could attract livestock farmers. Furthermore, insurance companies also offer conventional insurance to livestock farmers so that those who own too many cows to participate to the ADBNL scheme can already insure their herd. The development of an index based product for livestock farmers in Nepal would only make sense if there were a risk of covariate shocks that could make the existing ABNL scheme bankrupt. However this risk seems minimal so that we believe we should devote our efforts to other commodities.

A similar scheme has recently been introduced by ADBNL for vegetable farmers. While insurance companies do not offer coverage to vegetable farmers, the ADBNL scheme seems to offer farmers an adequate protection against idiosyncratic risks for a very low price. Index insurance could complement this scheme by insuring

farmers against covariate shocks, but here also, the importance (or even existence) of such covariate shocks does not seem to be well established so that the need for index insurance appears to be low. Furthermore, if some covariate shocks could sometimes hurt villages, it might be more efficient to simply pool farmers premiums (and the attached subsidies) in a larger fund at the district village (or another level that would make more sense) so that if a village suffers a shock, premiums collected in other villages can be transferred to indemnify farmers beyond the premiums they paid themselves. This possibility could be further investigated in Stage 2 of this feasibility study.

Other crops often remain excluded from the insurance market and this difference of treatment between livestock farmers and other farmers also appears in the access to credit.

5. Credit to small farmers

Depending on the commodity they produce, their location, and their participation to cooperative, Nepalese farmers can have different access to credit. As in the case of insurance, the credit sector focuses on livestock farmers, and opened recently to vegetable farmers. However, credit to cereal crop farmers remains very limited; Cereal crop farmers can only access collateralized credit where they put their home and/or land in guarantee for the loan. Many banks offer their services to farmers in Nepal, we describe below two typical banks, Sana Kisan Bikas bank, a semi-public institution entirely oriented towards farmers, and Muktinah Bikas Bank, a private bank who offers loans to farmers through its Micro-Finance branches.

Sana Kisan Bikas Bank

The Kisan Bank offers credit to farmers' cooperatives at a 5% interest. The cooperatives can then offer credit to their members (9% interest for livestock farmers and 10-15% for crop farmers). When a farmer defaults, the cooperative uses its resources (it cumulates provisions when a farmer start a new loan) to repay the bank so that the default rate for the bank is very close to 0%.

The Kisan bank's portfolio structure is: 40% livestock, 40% agriculture, 10% agro-processor, 10% other. The bank does not require collateral for loans up to Rs.100,000 but does require collateral for loans between Rs.100,000 and Rs.400,000, the maximum offered by the bank.

The Kisan Bank offers both short and long term loans. In the case of short term loans (6/12/18 months), the farmer repays the loan in 2 to 18 installments with a 3 month grace period; In the case of long term loans, they benefit from a 1 year grace period. 99% of the loans are repaid within three years.

Muktinah Bikas Bank

The Muktinah Bank operates as a *Modern Banking* bank (20 branches), *Limited Banking* bank (4 branches in rural areas) and as a *MFI* (22 branches). 30% of their clients reach the bank through its MFI branches, and its branches are concentrated in 10 districts in Western Nepal.

They offer non-collateralized loans to small farmers but farmers must at least subscribe a life insurance policy. In the case of livestock farmers, the Muktinah bank uses the ADBNL insurance program based on group responsibility.

The Muktinath Bank charges 20% interest rates for its loan to farmers, which is a standard value in Nepal for a loan from an MFI; interest rates in the informal sector can reach 40%.

The existence of the livestock insurance program implemented by the Agricultural Development Bank facilitates the access to credit for livestock farmers. Other crops often remain excluded from the credit market .Outside of the public banking sector, interest rates are high. We did discuss the possibility to use agricultural insurance to reduce interest rates with Muktinah Bikas bank, but they did not seem to be interested or have enough margin to significantly reduce their interest rates so that it could increase demand for credit. However, it is also possible that the bank keeps the same interest rates, but lowers the barriers to access to credit (proof of stable income, collateral, etc.).

One option to increase credit supply to crops (rice, maize, lentils, etc.) would be expand ADBNL's scheme to these crops. However, according to our discussions with agricultural experts in Nepal and some financial actors, it seems that the shocks that affect livestock farmers (or vegetable farmers) are different from the shocks crop farmers cope with. In the livestock sector, a shock will often cause the death or theft of one animal in a group,

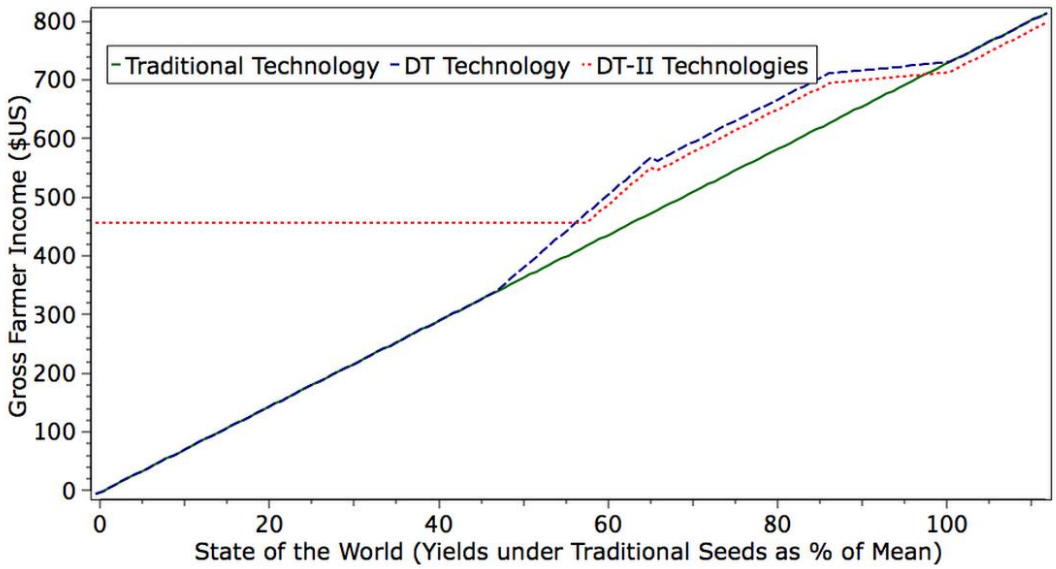
while crop farmers in a village will often experience the same shocks at the same time. In this case, it is not possible to mutualize risk among farmers of the same geographical zone; ADBNL's scheme cannot work.

6. Risk in Agriculture – Development impacts – Technologies available

So far we devoted our efforts to understand the risks farmers face to the case of crop farmers. Following USAID target crops, we investigated the case of (1) cereal crops (rice and maize) and (2) high value vegetables. Our objective was to understand the potential for development impacts of agricultural insurance. In particular, we were interested in the existence of new technologies that are under-adopted today because of risk, so that agricultural insurance could encourage farmers to adopt these new technologies that would increase their incomes.

The graph below shows an example of the complementarity between drought tolerant varieties and agricultural insurance. While drought tolerant varieties (blue dashed line) can improve yields compared to traditional varieties (green solid line) during moderate drought events, it cannot protect farmers against severe drought events. Agricultural insurance (red dotted line, coupled with drought tolerant seeds) instead is not a very efficient way of managing moderate risk (it would be very costly to minimize the deductible), but is designed to help farmers cope with extreme risk.

Figure 2 - The performance of bundled improve crop varieties and agricultural insurance in gross farmer income



Source: **Lybbert and Carter, 2013, Bundling Drought Tolerance & Index Insurance to reduce rural household vulnerability to drought**

I4/BASIS will work in order to fine tune an index insurance index that complements risk reduction technologies like stress tolerant varieties in order to provide farmers the best mix of instruments to manage agricultural risk.

The rice sector: Rice is the most important staple crop in Nepal and is grown mostly in the Terai. Most of the production is rainfed, so that is very vulnerable to the timing and intensity of the monsoon in the region. According to the Ministry of Agricultural Development in Nepal, rice should be our priority in this project. Indeed, because of delayed monsoon and low rainfall levels, the average national paddy transplantation rate, as of August 8, 2014, stands at 77 percent of 1.52 million hectares of paddy fields. The rate was 95.6 percent in the same period a year ago. Many farmers decided to abandon rice production this year, and invested in pulse or maize, incurring very significant costs. For those who decided to plant rice, low rainfall levels during the monsoon might reduce yields this year and could have dramatic consequences on nutrition and incomes. In order to prevent or limit the impact of such shocks, it is important to help farmers adopt risk-mitigating technologies (for example drought/flood tolerant varieties) and implement mechanisms that help them cope with risk when a bad event occurs (for example, agricultural insurance)

In order to help farmers become more resilient to the risks related to the monsoon, IRRI (International Rice Research Institute) developed several improved varieties of drought tolerant or submergence tolerant rice. These seeds do not necessarily produce higher yield during normal weather conditions but they outperform local seeds in situation of stress (drought or flood). Such varieties might be extremely useful in a changing environment induced by global warming. The Department Of Hydrology and Meteorology of Nepal is currently working at expanding its network of weather stations and provides weather forecasts that could help farmers choose which kind of variety they want to use depending on the risk of flood relative to the risk of drought.

Only 15-20% of rice farmers have adopted these new seeds. IRRI is working to help farmers adopt these new varieties. IRRI distributes starter kits to the farmers so that they can plant these new seed on a small plot. If they are convinced, IRRI makes farmers form a group and helps them produce and market their seeds. The cost of these seeds is comparable to the cost of local seeds (5-10% higher).

Another technology that IRRI tested recently is laser leveling. According to their tests, laser leveling can increase yield by 10-15%, but the technology is costly and farmers would need to take group loans over several years if they want to use this leveling technology.

The RIICE consortium (GIZ, Swiss Agency for Development, IRRI, Allianz and SARMAP) developed a model for rice mapping and yield prediction in the region (Philippines, Thailand, India, Vietnam, Indonesia, Cambodia and Bangladesh) and is willing to expand its program to Nepal in the near future (spring 2015). The final objective of RIICE is to develop an index insurance model suited to the South Asia conditions. I4 and RIICE

teams are currently discussing the technical details of the RIICE model to determine how it could be used for insurance purposes (historical data, resolution, accuracy, etc.).

The following is extracted from documents provided by RIICE:

RIICE – Remote Sensing based Information and Insurance for Crops in emerging Economies - operates in 12 sites across six countries in Asia (India, Thailand, Cambodia, Vietnam, Philippines and Indonesia) to develop, test, implement and build capacity in best practices for (i) remote sensing based monitoring of rice crop area, yield and damages, (ii) fieldwork protocols, (iii) information delivery to stakeholders in food security and insurance realms. It also engages at national level to develop better crop insurance products in both public and private sectors. RIICE is a two phase project, 2012-2015 (and 2015-2018 [and RIICE intends to include Nepal in its list of target countries in 2015]) with the aim to improve regional information on crop productivity and crop losses for food security and crop insurance applications. The RIICE partners are SDC, GIZ, Allianz, Sarmap and IRRI.

RIICE can be divided into two major components (i) technology and best practice for accurate monitoring and rapid assessment of crop productivity and losses due to flood, drought and wind and (ii) crop insurance products that build upon this new source of information.

The technology employed by RIICE is based on radar imagery, which does not suffer from cloud coverage as optical sensors do. This is an important characteristic of this model as cloud coverage is important during the monsoon season.

- First radar imagery is employed to detect rice fields and estimate rice acreage. The radar signal behaves differently when it hits water, dry mud, concrete, leaves or any kind of material. In the case of flooded rice, as in Nepal, there is a very specific sequence of events that allow remote sensing experts to detect rice fields: first, before the monsoon starts, the fields are covered with dry mud. Then, when the monsoon starts, fields are flooded, and soon after that, rice is replanted in the flooded fields. This sequence of dry mud, water and then green coverage, typical of rice fields, can be detected by remote sensing. The resolution of radar imagery for this exercise varies between 20m and 50m (compared to 250m with MODIS, the most widely used optical sensor).
- When rice fields have been located, the RIICE team combines the Leaf Area Index (LAI, the number of layers of leaves per squared meter) measured using radar sensors and a crop growth model, ORYZA. ORYZA simulates rice yield for different soil types, weather conditions, water stress conditions, and rice varieties. This model is combined with remotely sensed LAI to better predict yield for the current season.

One objective of RIICE is to use this model as a tool for index insurance. The collection of radar imagery from ENVISAT and SENTINEL missions started in October 2002, so that we have about 12 year of data available now. Combined with the Nepalese Living Standard Surveys of 2004 and 2011, the National Census of Agriculture for 2002 and 2012, and the Yearbook District-level data, we have a good opportunity to calibrate this model and test its ability to predict yields accurately in Nepal.

Our preliminary discussions with the RIICE team are very encouraging as our areas of intervention are very complementary. Indeed, RIICE already has a model able to predict rice yield, but has not been able to convert it into an insurance product yet, while I4/BASIS would lack the technical knowledge to develop such a sophisticated combination between remote sensing and crop growth modeling, but has the skills to turn it into an insurance product (if possible). We are currently discussing the possibility of a partnership with RIICE on the project. We will communicate additional information to USAID about these discussions, the cost of the technology, etc. as the information becomes available.

Furthermore, I4/BASIS has some experience at using *optical* remote sensing methods (NDVI, LAI, ET, etc.), so that if cloud coverage does not prevent the use of optical sensors, the two methods could be compared.

Despite its importance of rice in Nepalese food basket, and its role as an income source in the Terai, rice producers have a very limited access to credit that constrains the adoption of improved production technologies. Furthermore, despite the important climate risks they face, rice farmers do not have access to insurance products. Combining the efforts of the RIICE team and I4/BASIS, we believe we could develop a very good insurance product that could reach many poor farmers in Nepal.

Using remote sensing technologies like RIICE or other models also offers the advantage that the government can support the program without distorting the market. Indeed, the Government of Nepal could, if it were interested in such option, buy the remotely sensed yield predictions for the entire country, and then make them publicly available so that insurance companies can develop insurance contracts using this technology without bearing the development costs. Also, our discussions with Beema Samiti indicated that such index insurance product could possibly benefit from the subsidy program if the product was approved.

The maize sector: Maize is grown in the Terai (winter maize) and in the Hills (summer maize). In the Hills, maize is grown as a staple crop while the 15%-20% largest farmer in Terai () can produce it as a cash crop sold to the feed industry. According to researchers at CIMMYT, one very promising combination of insurance and technology that could generate important development impacts is the introduction of hybrid seeds which suffered recently from cold temperatures that stop plants' reproductive stage leaving farmers with very low yields.

However, CIMMYT experts claim that the adoption of hybrid seeds could increase yield by 0.5 to 1 ton per hectare in the hills even without any change in fertilizer use. CIMMYT's Hill Maize Research Program and

CSISA (Cereal System Intensification for South Asia) put a lot of effort into the promotion of these varieties, and appropriate insurance products could perfectly complement their intervention.

The CIMMYT-CSISA team already made some steps to investigate the possibility of insurance for maize farmers in Nepal and would be ready to work with us on a preliminary assessment of the demand for maize insurance this summer/fall.

According to CIMMYT experts, efforts to develop index insurance for maize farmers could focus on (i) early mortality and (ii) cold damage for winter maize. The technology available for such exercise is yet to be developed though. Indeed, while it might be possible to use remote sensing techniques to measure early mortality, cold damage might be more difficult to measure. Taking the example of NDVI, early mortality would appear in the NDVI data as a drop in the level of photosynthesis activity which could be remotely sensed. However, cold damage does not impact leaves, but only the ability of the plant to reproduce: flowers are empty. In that case, remote sensing might not be able to detect the effect of cold damage. A solution to this issue might be to combine remote sensing data with a crop growth model that could simulate the impact of cold temperature episodes of yield productivity.

The development of an Index Insurance product for maize would somehow consist in the replication, to the maize sector, of the efforts developed by RIICE in the rice sector. Such model is however extremely difficult to develop and the timeframe of this feasibility study might not permit such experimental developments.

Livestock

The existence of ADBNL's scheme and existing commercial insurance products are important constraints to the development of other insurance solutions for livestock in Nepal. In addition to these existing products, some important technological issues would also limit our ability to develop a good index insurance product for livestock in Nepal.

First, if one wanted to insure mortality due to drought following IBLI (Index-Based Livestock Insurance)'s model implemented in Kenya, he would face the two major problems. First, Nepal's sky is often cloudy, which renders *optical sensors*, like MODIS the sensor adopted in the IBLI program, very difficult to use. Optical sensor can't detect pasture "colors" through clouds. Even if we could get enough good images from satellites, the feeding habits in Nepal don't necessarily allow for the use of remote sensing methods that try to measure the quality of grass in the fields, and lack of food due to drought (the kind of risk capture by this type of index) does not seem to be an important risk in Nepal:

- In the mountainous areas, herds are made up of yaks, chauries (yak–cattle crosses), cattle, sheep, goats and horses, reared in semi-pastoral or transhumant systems. Livestock move in an annual cycle according to their specific requirements and grazing availability at different altitudes.

- In the hills, livestock rearing is sedentary and animals make daily grazing forays and return every evening.
- In the Terai, cattle generally graze, but are also stall-fed on crop residues and forages Compared with the mid-hills, there is less grazing land and forest; so more crop residues are fed and the amount of stall-feeding relative to grazing is greater in the Terai than in the Mid hills. Although there can be shortage of feed in winter and before the onset of the monsoon, most productive and draught livestock are well looked after and others survive on the available grazing.

Instead of developing a substitute to existing livestock insurance products in Nepal that focus on mortality, it could also be possible to focus on other dimensions of livestock production like meat or milk production. In this case, an area yield index measuring average quantity of milk produced per day and per cow in a given region could be used to help farmers cope with exceptionally low milk production levels. However, the development of such index requires (i) to measure milk production at each collection center and to make sure that the entire (or a very large proportion of) production of milk passes through these collection centers and (ii) to measure the number of lactating cows at each collection center. These conditions are not fulfilled in Nepal.

High Value Vegetables

Both iDE (International Development Enterprises) and the KISAN teams strongly emphasized the role of vegetables in improving the lives of the poor in Nepal. Indeed, vegetables can be produced by farmers in the hills who are often more vulnerable and they can be produced off-season, generating a new flow of cash that does not require labor transfer from other agricultural activities.

The development of this vegetable market is structured around *Rural Collection Centers* which regroup at least 100 farmers each. More than 200 collection centers are already in place and serve about 100,000 households.

However, vegetable production requires the purchase of new seeds and important investments on the farm (water tanks, irrigation system, plastic sheets), but farmers are liquidity-constrained.

From formation, groups of farmers are linked to a buyer who will provide seeds, credit and a market for the output. When the group develops, it can turn into a cooperative who buys individual output and market it to farmers. However, the question of access to credit remains important for large investments in irrigation systems, etc. iDE is currently working together with the Frankfurt School of Business and Management, the Agricultural Development Bank and the Mukthinath Bank to improve vegetable farmers' access to credit.

In order to cope with risk (hail storm, insects, pest, diseases) they also implement the ADBNL insurance scheme where vegetable farmers pay a premium (the government also contributes subsidy to the premium) to the collection center; the collection center can then use this amount to offer loans to its members or use it for

insurance purposes. However, since the collection centers don't pool their resources to mutualize risk, each group might be exposed to shocks that could affect the entire community.

Given the existence of ADBNL's scheme, the absence of yield data and the impossibility to use remote sensing to predict yields for vegetables, it would be difficult to develop a real insurance product for vegetables. However, a cheap way to help farmers cope with aggregate shocks using the existing setting developed by ADBNL could consist in the pooling of groups' premiums into a larger pool that could cover an entire district (or a larger area). In this case, when an entire group suffers from a shock, it could still be fully indemnified using other groups' premiums. Mutualizing risk this way would help farmers recover after shocks that affect the entire community.

Conclusions

The objective of this first stage of the feasibility study was to identify a short list of commodities and areas where Index Insurance could be an appropriate risk management tool that would have significant development impacts for farmers. Given the absence of appropriate yield data in Nepal, it appears that remote sensing techniques are the best way to develop such product for Nepal. However, geography and climate in Nepal make the use of remote sensing techniques particularly challenging (land fragmentation, diversity of crop grown, diverse terrain, cloud coverage, etc.). The only promising option seems to be the development of index insurance for paddy farmers. Indeed, rice fulfills all the following conditions:

- Rice is an important crop for farmers in Nepal. It is a key crop in Nepalese diet, and also an important income source for farmers in the Terai.
- There exists no other insurance product for rice farmers in Nepal
- Three exist plenty of investment opportunities for rice farmers if they had access to credit.
- The limited access to credit for rice farmers is clearly due to the high unpredictability of yield.
- There exist some potential good indices to predict rice yields and that could be employed as an index.

Among the several commodities analyzed in this first stage, rice is the only crop that could fulfill all these criteria , so we suggest we bring this single crop to Stage 2 where we will test several potential indices and design an index insurance contract that could be tested in a pilot project.