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Conservation Agriculture
and Sustainable Upland Livelihoods

Innovations for, with and by Farmers
to Adapt to Local and Global Changes

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Conservation Agriculture and Sustainable Upland Livelihoods : Innovations for, with and by Farmers to Adapt to Local and Global Changes

Proceedings of the Conference held in Ha Noi, Vietnam
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Farmers' perception of soil erosion as a risk to their livelihood – scenario analysis with farmers in the northern mountainous region of Vietnam

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Soil erosion is a major factor limiting sustainable maize production in the northern mountainous region of Vietnam. Erosion problems are complex owing to a combination of socioeconomic factors (including increased population pressure, land scarcity and market development) and common agricultural practices (including burning of organic residues, ploughing on slopes and free grazing) (Valentin et al. 2008). Vietnamese scientists, supported through a range of internationally funded research projects, have addressed erosion problems on sloping lands for many years, and various technologies have been developed, including mulch-based direct sowing, mini-terraces, intercropping with legumes, and diversification and rotation of crops (Le et al. 2003, Ha et al. 2003, Le and Ha 2008). Unfortunately, even though these erosion prevention methods did appear to be effective at the research sites, scaling up of production systems that use these methods has been slow and challenging (Le et al. 2003). This abstract outlines a preliminary social inquiry undertaken in 2011 and 2012 as a component of an ACIAR-funded project that investigated farmers' perceptions of soil erosion as a risk to their livelihood in an attempt to explain the slow adoption of erosion management practices.

The inquiry was influenced by the work of Schoell and Binder (2009), who developed a structured mental-models approach to investigate farmers' perceptions of risk. In this model, farmers' perceptions are elicited in the context of their livelihood. The perceptions are then compared with the scientists' perceptions about farmers' attitudes towards erosion. Our inquiry was based on a scenario analysis, which involved three steps.

The first step was a workshop with Vietnamese scientists involved in research on sustainable management of sloping lands in Lai Chau and Son La provinces. The aim of the workshop was to identify the scientists' perception of farmers' understanding and attitudes towards soil erosion.

The second step was for Vietnamese scientists to develop scenarios of potential risks of soil erosion that would then be used to facilitate discussions with farmers. Three scenarios were developed.

The first scenario described a positive outcome for farmers. With the help of local government and extension services, farmers would change their practices to a sustainable soil management system that reduces erosion and brings long-terms benefits, despite the initial increase in labour input. In the second scenario, farmers are not managing their land appropriately and sell their land to an international company to compensate for declining productivity. The company invests in sustainable soil management and, as a result, increases productivity. After farmers realise that the land production capacity is much higher than first thought they want to buy it back. However, that is not possible, as the company is not willing to sell the land back, and the farmers have spent the money they received for the land. Finally farmers have to move from their village in search of work elsewhere. The third scenario describes the disastrous long-term consequences of soil erosion if farmers did not change their practices. The fertility of their land and, consequently, their income declines to the level where farmers can no longer afford to pay the school fees for their children and they hardly have enough food to eat. In desperation, the farmers either break the law and cut the forest to claim more land but then have to face the legal consequences, or leave their village to look for work.

The third step involved discussion sessions with farmers around the three scenarios. In each commune, these discussion sessions where held with two groups of farmers separately, one that was directly involved in the ACIAR project activities, the other with no prior involvement. The sessions were conducted in Lai Chau province with farmers in Ban Bo and Giang Ma communes, and in Son La province in Na Ot and Phieng Luong communes. Open-ended questions were asked to probe for the farmers' opinions about the scenarios.

Scenario analysis revealed that farmers are aware of soil erosion. In three of the four communities, the farmers see erosion as a problem for the next generation, but they believe that for the time being they can compensate for the loss of soil by increasing fertiliser use. The lack of mulching material and additional labour required to practise erosion management methods are perceived as the main barriers to the implementation of sustainable soil management. Farmers not directly involved in the project have a stronger sense of loyalty to traditions than farmer researchers participating in the trials, and some see the use of existing cultivation practices as hanging to their 'culture'. Farmer researchers, moreover, see the change of practices more as a risk than an opportunity, but they are more open to change if they can see clear short-term benefits of the change, such as reduced labour input with minimum tillage.

It is interesting that all of the farmer groups engaged in the sessions could outline contingency plans if erosion reduced the fertility of the land to the level where they could not grow maize anymore.

These contingency plans include the management of different cropping systems such as agroforestry, selling eroded land and buying new land, cutting forests and moving to new areas. Although most communities have communal regulations on the use of water, land and forest, decisions on how to farm and how to mitigate soil fertility problems are made at the household rather than the community level, and hence through the action of individuals, not through collective action.

All groups agreed that the scenarios presented were realistic, indicating that Vietnamese scientists had a good understanding of the farmers' perceptions of erosion. However, the notion of the scientists and extension officers that farmers do not care about erosion is an oversimplification. Farmers are aware of both the problem of erosion and to some extent the methods of mitigation, but they have other priorities and shorter-term goals that need to be addressed to maintain current production and cash flow. For them, erosion, with all its associated problems, is a longer-term risk that the next generation will have to deal with. In this context, to be adopted by farmers, any erosion management strategy will have to have some short-term benefits in order to be accepted by farmers.

Keywords

Farmer perceptions, risk management

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Framework, dynamics and challenges of transdisciplinary research-for-development on sustainable land management in the north-western highlands of Vietnam

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The complex dynamics of rural communities and the major economic and environmental threats looming worldwide make it necessary to link science with farmers' realities to achieve sustainable change (e.g. Pohl 2005; Lieblein et al. 2008; Van de Fliert et al. 2010). Biophysical, agricultural, economic and social scientists, development practitioners and communities need a shared understanding of these complex realities to enable collaborative and complementary learning. The management of sloping agricultural land in the north-western highlands of Vietnam, a relatively poor and ethnically diverse area, is a complex situation in which a transdisciplinary approach is needed to find sustainable solutions that are acceptable to the local communities. Since the 1990s, production of maize has been the major driver of rural development in north-western Vietnam, resulting in significant increases in farmers' income, but at the same time causing severe soil erosion. Although government and development organisations have been supporting research that makes effective soil conservation techniques available, none of these techniques have been widely taken up by farmers.

A project funded by ACIAR in north-western Vietnam has been addressing this disparity between the availability of research outputs and their on-farm use within a transdisciplinary and transinstitutional framework. This framework emphasises the importance of adaptive research involving the collaboration of farming communities, local government, extension services and biophysical and social scientists. Technical trials evaluating and adapting technologies on farm within the specific local agroecological and socioeconomic context are coupled with the design and testing of ways to share innovations on a larger scale. Through annual workshops and field-based participatory monitoring and evaluation, research is developed and results are analysed in consideration of the viewpoints of all stakeholders. Linkages with the provincial extension system were established early on, and mechanisms were developed to support outreach of the results beyond the scope of the project.

The project runs from early 2009 until the end of 2013.

Regular reviews and improvements have kept the framework effective under changing conditions. Although the project still faces challenges to scale up sustainable agricultural practices, stakeholder participation has improved significantly and the use of sustainable farming practices in the project locations has been successfully promoted.

Our experiences show that all stakeholders need to be engaged in the development of a shared methodology. It takes a considerable amount of time to establish the required willingness and capacity of transdisciplinary research teams to function effectively. Our experience shows that it is easier to manage these collaborative structures at the field level than to establish institutional mechanisms that support transdisciplinary and transinstitutional collaboration. Moreover, there is often a conflict between the goals of the funding bodies and the requirements of implementing transdisciplinary research-for-development on the ground.

Keywords

Transdisciplinary collaboration; research for development; sustainable agriculture

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Assessing the contribution of participatory approaches to sustainable impacts of agricultural research-for-development in the northwest highlands of Vietnam

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The northwest highlands of Vietnam are characterised by high ethnic diversity and typical mountainous topography. The highlands include six provinces with a total area of 5.07 million ha, which accounts for 15.32% of the whole country (NOMAFSI, 2012). These provinces are home to over 30 ethnic minority groups. The highlands are diverse not only in culture and ethnicity, but also in their degree of connectedness to markets. A harsh natural setting, increasing population pressure and low education of local people are major causes of unsustainable management of agroecosystems (Van de Fliert, 2008). Moreover, extension programs have not paid adequate attention to the participation of the local communities and their knowledge (Thai et al., 2011). These factors have led to unsustainable development in the northwest highlands.

In recognition of these problems, the Vietnamese government and international development agencies (e.g. World Bank, FAO, UNDP, ACIAR, CIRAD) have invested heavily since the early 1990s through various social and economic development policies and research initiatives. Most agricultural research projects have aimed at economic development through increasing agricultural production and improving market engagement. However, research-for-development, targeting the immediate use of research outputs for development purposes, appeared in the late 2000s. Participatory approaches have been adopted in several of these projects in an attempt to better link research with development, but with varying approaches towards stakeholder engagement, ranging from using farmers as field labourers to involving them as co-researchers. It is generally assumed, but increasingly debated and mostly not proven, that farmer participation enhances the applicability of research outputs. Understanding the contribution of a participatory approach towards sustainable impacts will be very important for informing agricultural research-for-development strategies in the future.

Assessing the impact of agricultural research and the contribution of a participatory approach in research projects in the northwest highlands remains problematic in terms of both objectives and methods.

Firstly, most agricultural research initiatives involve only short-term impact assessment, while research-for-development often takes a long time to achieve results.

Secondly, current impact assessment practices tend to focus more on economic impacts and ignore human, social, physical and natural impacts, which are also vital capital components of a sustainable livelihood.

Thirdly, although various participatory tools have been used in impact assessment, ethnic diversity means that in many cases local people have not been empowered, owing to gaps in the researchers' understanding of social culture, languages and perceptions.

Fourthly, the results and findings of current impact assessment approaches have sometimes been misleading, attributing greater impact to a single project and ignoring the synergistic effects of simultaneous initiatives in the same area.

Finally, the impact indicators and feedback mechanisms currently used for impact assessment often measure the returns on investment or the cost-effectiveness for donor organisations rather than the sustainability of these impacts for key stakeholders. These limitations have led to unconvincing evidence showing how and why specific research and development approaches have contributed to (or, rather, failed to deliver) sustainable impacts.

As in any development activity, assessing the impact of agricultural research projects is crucial to sustainable development (Cromwell et al., 2001; Krall et al., 2003). The selection of an appropriate impact assessment method for a particular project will help to achieve good indicators at different levels of contributions (Meinzen-Dick et al., 2003; Tran et al., 2008). The results of impact assessment not only are crucial for learning about the impacts of research-for-development, but also offer suggestions for the formulation of appropriate measures and strategies towards sustainable development of the target areas (Cramb et al., 2003; Krall et al., 2003). A holistic approach towards assessing the impacts of agricultural research-for-development, underpinned by participatory communication strategies, is important to supporting sustainable social change.

This paper reviews existing impact assessment approaches for agricultural research projects as practised since the 1990s in the northwest highlands, and discusses their strengths and weaknesses. It concludes with a suggestion for an alternative impact assessment framework for agricultural research-for-development projects that is developed from a comprehensive livelihoods perspective in a region with variable stages of agricultural development and social change.

Keywords

Impact assessment; agroecosystems; research-for-development

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Adaptive participatory research to develop innovations for sustainable intensification of maize-based farming systems in the northern uplands of Vietnam

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In the northern mountainous region (NMR) of Vietnam, maize (*Zea mays*) is one of the most important crops. The region's total maize area exceeded 460 000 ha (>40% of the total) in 2010, producing over 1.5 million t of grain (>31% of the total production of maize in the country) (General Statistics Office, 2011). Increasing demands for maize by the feed industry and increasing cash requirements of local rural households have resulted in continuous expansion of the maize area and intensification of production. This has pushed maize cultivation onto degraded sloping lands. Maize crops in the NMR have already climbed up and often reached the tops of slopes with an inclination of over 25°, despite government efforts to restrict the cultivation of annual crops to flatter lands at lower elevations. This has created the need for the on-farm application of technical innovations to support sustainable intensification of maize production and for the restoration of degraded sloping lands. Significant attempts have been made to develop sustainable soil management techniques, including mulching, mini-terracing and intercropping. These techniques were effective at soil protection and to a certain extent increased the profitability of maize crops (Le at al., 2003; Le and Ha, 2008). Nevertheless, although they have been available for many years, they have not been applied on a large scale, and some tens to hundreds of tonnes of soil continue to be washed away from each hectare of sloping land in the NMR every year (Kirchhof et al., 2012). One of the main reasons for the low adoption of erosion management is the incompatibility of the recommended techniques with the socio-economic characteristics of smallholder farmers in the NMR (Nicetic et al., 2012).

Aiming to design techniques of mulching, mini-terracing and intercropping that smallholder maize farmers in the NMR can successfully adopt, in collaboration with local farmers, we began research in 2009 in six locations with different land, climatic and socioeconomic conditions: research sites were established in six communes in Son La and Lai Chau provinces.

The experiments were planned, established, conducted and evaluated in collaboration with farmers on their own farms. Farmers carried out most of the field work, and took part in regular monitoring and evaluation of the experiments. At harvest, the farmer-researchers and other farmers offered their observations and opinions in community feedback meetings.

An economic analysis of each technique was done with the farmer-researchers and was presented at the meetings. Discussion of both positive and negative impacts of the techniques allowed the techniques to be modified. The modified techniques were then tested in the following season, and the monitoring and evaluation was repeated. Two to four cycles of this participatory adaptive research resulted in soil erosion management techniques that are applicable to the prevailing socioeconomic and environmental conditions at each site.

It has become clear after 3 years that location-specific adaptation is necessary to make the techniques attractive to farmers, and that "small" modifications can have a deciding role in enhancing adoption. A good example is provided by the development of suitable soil cover techniques. The previous recommendation of 5–7 t/ha of plant residues appeared to be too much to allow maize seeds to germinate normally. Our observations showed that half of this amount still had good erosion prevention effects while improving seed germination. In addition, field-based trials showed that, depending on the time interval between the harvest of one crop and the sowing of the next, different treatments of mulching materials might be required. The main concern that became evident, and is still a key question, is how farmers can collect or produce enough mulching materials. Currently, free grazing during autumn and winter limits the availability of maize crop residues to be used for mulching in the next crop. As a result, relay crops or intercrops need to be grown for biomass production, and fields have to be fenced or guarded to keep stock out. But in the NMR, where both the rate and the density of poverty remain the highest within Vietnam, plants with no immediate economic value would not be accepted, and there is no perception among farmers that soil cover provides value. Indeed, different intercrops were initially accepted not because of their soil protection value, but for their economic or use values. For example, Guatemala grass (*Tripsacum laxum*) was accepted in one location where buffaloes were raised; soybean in another, where farmers had the knowledge and skills to manage intercropped soybean for good economic return; and rice bean (*Vigna umbellata*) in yet another, where it was traditionally cultivated with maize for human consumption. The methods for planting intercrops also differed from location to location, with variations in row distance and intercrop density.

Similarly, variations in tillage methods were required. The appropriateness of land preparation and sowing methods, given the availability of labour, draft animals, agricultural mechanisation and soil cultivation tools, primarily determined their adoptability. In the NMR, where labour is short at critical times and there are no readily available tools for direct sowing, minimum tillage, whereby furrows are made either by cultivator pulled by buffalo or manually by hoes, is preferred to zero tillage.

Out of various options for land preparation and seed sowing recommended by our project, farmers in different locations have made different choices depending on their soil structure, land area, land slope, and labour and tool availability. For instance, famers in one location with small plots on rocky soils chose to use hoes to make furrows or holes for fertilisers and seeds, while on larger areas they used buffaloes to make furrows.

In another location, where the soil was very poor and hard, in the first year farmers decided to plough and then apply mulch.

In summary, the specific ethnic, socioeconomic, land, climatic and topographical conditions of the NMR militate against the adoption of a conventional conservation agriculture approach of no soil disturbance and permanent soil cover. Through adaptive participatory research, our project developed adaptable soil management techniques based on the principles of mulching, minimum tillage, mini-terracing and intercropping that can be widely applied by smallholder maize farmers in the NMR.

Keywords

Sustainable agriculture, adaptive research, erosion control, north-western Vietnam

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Farmer-friendly erosion control measures in maize-based systems of the northern mountainous region of Vietnam

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We evaluated soil erosion rates in farmers' fields to assess when erosion occurs during the maize season and to identify which soil management practices best reduce erosion. We used a modified profile meter method to monitor erosion (Hudson 1993). Unlike Wischmeier plots, this method has minimum impact on farm operations. In brief, it monitors the drop in soil surface level below fixed reference points, which are steel pegs (pins) driven into the soil: the distance between the top of the peg and the soil surface is measured following a rainfall event. We inserted 4 pegs into the ground to ~40 cm in a 70-cm x 100-cm rectangle and monitored the distance at 8 constant locations within this erosion station. Measurement errors using this method can be large, owing to slumping of soils after tillage and to soil swelling. We compensated by taking a large number of measurements, monitoring soil bulk density to account for slumping, and assuming negligible shrink–swell on these 1:1-type clay soils. Although slumping occurred, it happened very quickly after tillage following rainfall; once the maize was sown, slumping was no longer observed.

The research comprised two phases: collection of baseline date on erosion; and monitoring soil erosion in field experiments in two communes, Na Ot (Son La) and La Nga (Moc Chau). The field trials used a randomised complete design with 4 blocks. Each plot had 2 erosion monitoring stations, and erosion was measured 8 times during the maize season at Na Ot and 10 times at La Nga. Slopes were ~25º. We also measured rainfall intensity, final maize yield, bulk density and single-ring infiltration rate. Following discussion with farmers, treatments were adjusted to what the farmers though they may use in future. The soil at both sites was cultivated with a hand hoe.

There were 4 treatments at La Nga: minimum cultivation with residues retained; cultivation with residues retained; cultivation with residues retained plus additional mulch; and cultivation with residues retained and rice bean (*Vigna unguiculata*) intercropping. No burning took place.

The quantities of residue retained ranged from 1 to 3 Mg/ha, and those of additional mulch ranged from 3 to 5 Mg/ha.

There were 4 treatments at Na Ot: slash and burn; cultivation with residues retained; residues retained and mini-terraces; and minimum cultivation with residues retained.

The quantities of residue retained averaged 4.3 Mg/ha with an average ground coverage of 83% before land preparation. The difference in residues between the two sites is due to grazing during the dry season.

For the baseline study, erosion was monitored in fields of 5 villages from late July to mid October on 5 dates. These villages are located in different communes in 4 provinces (Mai Sơn, Moc Chau, Sin Ho, Tam Đường). Erosion stations were located on slopes of between 20º and 30º on slope lengths longer than 100 m. The 68 erosion stations were distributed unevenly between fields, as we depended on access and farmer support to take measurements. Average soil loss ranged from 8 to 15 Mg/ha during that time, and there were no significant differences between provinces, communes or fields. We attributed these low erosion rates to the late onset of the monitoring schedule: the maize was well established and provided effective erosion protection by reducing raindrop impact. Visual assessment of erosion showed that most erosion occurs during the early phase of the growing season while the soil is unprotected.

During the 2011 maize season, average erosion at La Nga was 38 Mg/ha, with a very large variation (3–95 Mg/ha), but there were no significant differences between treatments, and it was not possible to differentiate between erosion rates at the start and towards the end of the season. We attributed the lack of significant differences to the retention of residues in all treatments and to the inherent variability of the measurement method we used.

Total erosion rates were much higher at Na Ot, and segmental regression showed a significant difference between the start and the end of the maize season. Most erosion occurred by 7 July 2011. The first measurement was taken on 22 April, and maize was sown on 11 May. This suggests that a large proportion of soil loss follows land preparation, before the maize is planted, and is aggravated by weeding (Podwojewski et al. 2008). Initial soil loss was 226 Mg/ha in the slash and burn treatment. There were no significant differences between the other treatments, in which residue was maintained; the average initial soil loss was 101 Mg/ha. The difference between residue burnt and residue maintained was significant at the 5% level. The average soil loss rate after 7 July 2011 was 17 Mg/ha (5–25 Mg/ha), and there were no significant differences between treatments.

The results show that most soil erosion occurs within the first 2 months of the cropping season, and the main factor in reducing erosion is the maintenance of ground cover. Therefore, the best way to reduce erosion is to encourage farmers not to burn, but to maintain crop residues.

Keywords

Soil erosion, participatory research, Zea mays, conservation agriculture, residue retention

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