

Market-based strategies to upscale organic fertilizer use in Nepal to achieve productivity, resilience, and the SDGs

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Nepal's current Agricultural Development Strategy recognizes the need to increase the levels of soil organic matter for productive and sustainable agriculture, and the important role commercial organic fertilizers can play in that process. It advocates for a gradual shift from chemical intensive to more sustainable farming systems; i.e. application of organic as well as balanced inorganic fertilizers to enable sustained levels of production without degrading the soil and environment. To date there has been limited use of commercial organic fertilizers in Nepal. However, recent research has confirmed that semi-organic fertilizer regimes increase yield and enterprises producing organic fertilizers and other soil improvers can be viable. Research has also shown that farmers will use such products if the quality and availability can be assured. This article analyses the situation in Nepal and proposes market-based strategies for policy makers to address the quality and availability issues so that organic matter markets can drive a transition to more productive, sustainable (agroecological), and inclusive agriculture, and thereby enable progress towards agriculture, nutrition, and poverty targets in the SDGs.

Keywords: Sustainable Development Goals (SDGs), soil fertility, soil organic matter, organic fertilizer, market systems, Nepal

PRODUCTIVE, SUSTAINABLE, AND INCLUSIVE AGRICULTURE is needed to achieve the Sustainable Development Goals (SDGs) which, among other things, ask for policies and action to support small-scale farmers, safe and nutritious food, and protection against climate change. In Nepal, agriculture in the productive lowlands (the *terai*) is additionally challenged by declining soil organic matter caused by successive decades of intensive, external-input-dependent farming.

Scientists and farmers have shown that agroecological farming can be productive, sustainable, and inclusive (numerous examples can be seen in the proceedings of the first FAO symposium on agroecology; FAO, 2014), as well as a means of improving resilience to drought and climate change. However, a transition to agroecological farming is very difficult for commercial farmers who, like the Nepali farmers of the *terai*, are already dependent on mechanized, intensive agriculture.

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Other countries already recommend using organic fertilizers, composts, or other means of increasing soil organic matter to increase soil fertility in addition to balanced inorganic fertilizers (e.g. Bangladesh fertilizer recommendations; BARC, 2012). It is postulated that in intensive agricultural contexts, the addition of organic fertilizers or organic 'soil improvers' could enable a transition to more agroecological practices. The availability of quality organic fertilizer or soil improvers is a problem which can only be solved at scale if there is greater engagement by agribusinesses and investors in organic matter value chains (i.e. viable enterprises manufacturing and supplying organic fertilizer, composts, or other soil improvers).

This article builds on a study of the organic fertilizer sub-sector in Nepal that was carried out in order to develop market-based strategies to address the low and falling levels of soil organic matter (Practical Action, 2016). To date there has been little use of market-based strategies to promote agroecology. This work is the beginning of a novel and innovative long-term programme to promote a transition to more agroecological farming at scale, and thereby progress towards the agriculture, nutrition, and poverty targets of the SDGs.

Background

Agriculture is a major component of the Nepalese economy which provides employment to 75 per cent of rural people and contributes to around 33 per cent of GDP (Government of Nepal, 2012/13). Subsistence agriculture is dominant in the hilly and mountain regions of the country, whereas commercial agriculture is dominant in the *terai* (lowland) where indiscriminate fertilizer use and repeated intensive cropping is having an adverse impact on soil health and the environment. Studies have revealed soil organic matter decreases with heavy use of chemical fertilizer (Tripathi, 2002). In 2010 the average soil organic matter content in the *terai* was 1 per cent which contrasts with the 2015–2035 Agriculture Development Strategy (ADS) target of 4 per cent (Ministry of Agricultural Development, 2016).

Nepalese agricultural policies and plans rely on chemical fertilizer to ensure national food security. For several years subsidies have been in place to support the use of chemical fertilizer. The mechanism uses price and transport subsidies which vary from year to year. In 2011/2012, 422,547 metric tonnes (Mt) of NPK fertilizers (nitrogen, phosphorus, and potassium) were imported and sold at a subsidized rate through agricultural cooperatives. It is estimated that this is only 25 per cent of the total quantity used and the remaining 75 per cent was imported informally (ADB, 2013) – i.e. illegally from India through the long and porous border. It is also estimated that the demand for chemical fertilizers in the country is increasing by 15 per cent per annum (AICL, 2013). The increased use of chemical fertilizer is not proportionate to use of organic matter in the soil. This imbalance in the use of inorganic and organic fertilizers is causing deterioration in the soil health of commercial farms in Nepal.

The context above, combined with the emergence of new kinds of organic fertilizers, new market actors, and dangerously low levels of soil organic matter has motivated the government to set a target for increasing soil organic matter from 1 per cent to 4 per cent (Ministry of Agricultural Development, 2016). To achieve

this, the government has introduced subsidies on equipment for organic fertilizer manufacturing and on the price of organic fertilizer at farm level. The following subsidies are available:

- up to 50 per cent subsidy on equipment cost;
- NRs10/kg (US\$0.09/kg) subsidy on organic fertilizer for farmers (up to 1,500 kg; through a voucher scheme based on legal documents submitted to the district agriculture development office);
- NRs25,000 (\$233) cash support for households who establish vermi composting;
- NRs5,000 (\$47) cash support for households for cow-shed improvements to collect urine and cow dung.

In spite of these incentives, the use of organic fertilizer has not been encouraging in Nepal.

Fertilizer value chains in Nepal

Cow dung and poultry manure has been used by farmers to improve soil fertility for generations. However an increasing demand for energy is now competing for this organic matter. Some large poultry farms use the litter to generate biogas. Similarly it is now common for cow dung to be used to generate biogas for cooking at the household level. Some big livestock farms and cooperatives use biogas to generate electricity.

Recently certain organic wastes and by-products have also been used to produce commercial organic fertilizer in Nepal: estimated at around 15,000 Mt annually. The total market share of commercial organic fertilizer relative to the use of chemical fertilizer is negligible (<1 per cent). Figures 1 and 2 show the main market channels of organic fertilizer in Nepal. Most organic fertilizers (>99 per cent) come from local organic fertilizer companies. Only a very small amount (<1 per cent) is imported. The figures show the engagement of many actors in production, import, and distribution. In the case of locally manufactured organic fertilizer (Figure 1), around 80 per cent is supplied through cooperatives and the remaining 20 per cent through agro vets, company dealers, or the District Agro-Input Corporation (DAIC). In the case of imported organic fertilizer (Figure 2), 60 per cent is supplied through local suppliers and dealers and 35 per cent is through agro-vets. Very little is supplied through cooperatives (around 5 per cent).

Key features of the current organic fertilizer sector in Nepal (see Figure 3)

- *Production.* Several small, medium, and a few large companies produce different types of organic fertilizers (15,000 Mt/year, such as vermi-compost, granular, and dust) under different brand names in Nepal. As most farming systems include both crops and livestock, the use of farm yard manure (FYM) and composts (produced by farmers themselves) is also very common.
- *Imports.* Several large (national) dealers import some organic fertilizers from abroad; however, the volumes are minimal compared with the need and use of organic fertilizer in the country (less than 1 per cent).

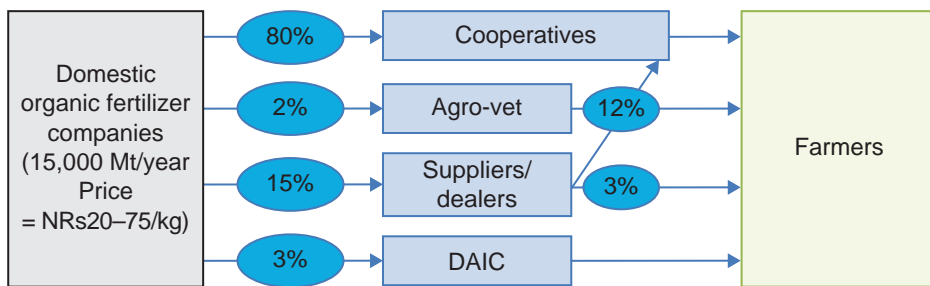


Figure 1 Market channels of domestically produced organic fertilizers

Note: US\$1 = NRs107 as of September 2016

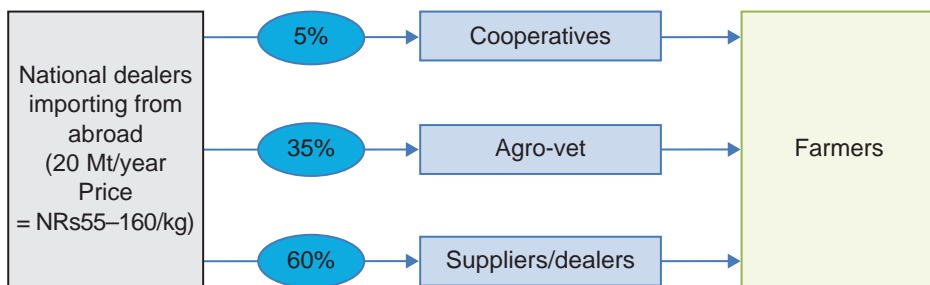


Figure 2 Market channels of imported organic fertilizers

Note: US\$1 = NRs107 as of September 2016

- *Distribution.* Cooperatives are the main distributors of domestically produced organic fertilizer. Agro-vets are the main distributors of the imported organic fertilizer. This is because it is supplied by the same companies that provide them with inorganic fertilizer. The cooperatives tend to supply fertilizers with a minimal profit margin.
- Several actors are interested in promoting the production, distribution, and use of organic fertilizers. These include the National Agriculture Research Council (NARC), the Soil Management Directorate (SMD), international and national NGOs, District Agriculture Development Offices (DADO), and the Agriculture Input Corporation Limited (AICL). The current organic fertilizer market system, however, has few actors (mainly the District Agriculture Input Corporation (DAIC) and farmers' cooperatives), is not well coordinated, and does not function well.

The costs and benefits of using organic fertilizer

A recent analysis of the costs and gross margin of production by farmers in Chitwan showed that using a mix of organic and inorganic fertilizers was the most profitable (Practical Action, 2016). The analysis was based on a survey of 90 households of the Chitwan and Kathmandu districts, as well as focus group discussions with multiple actors.

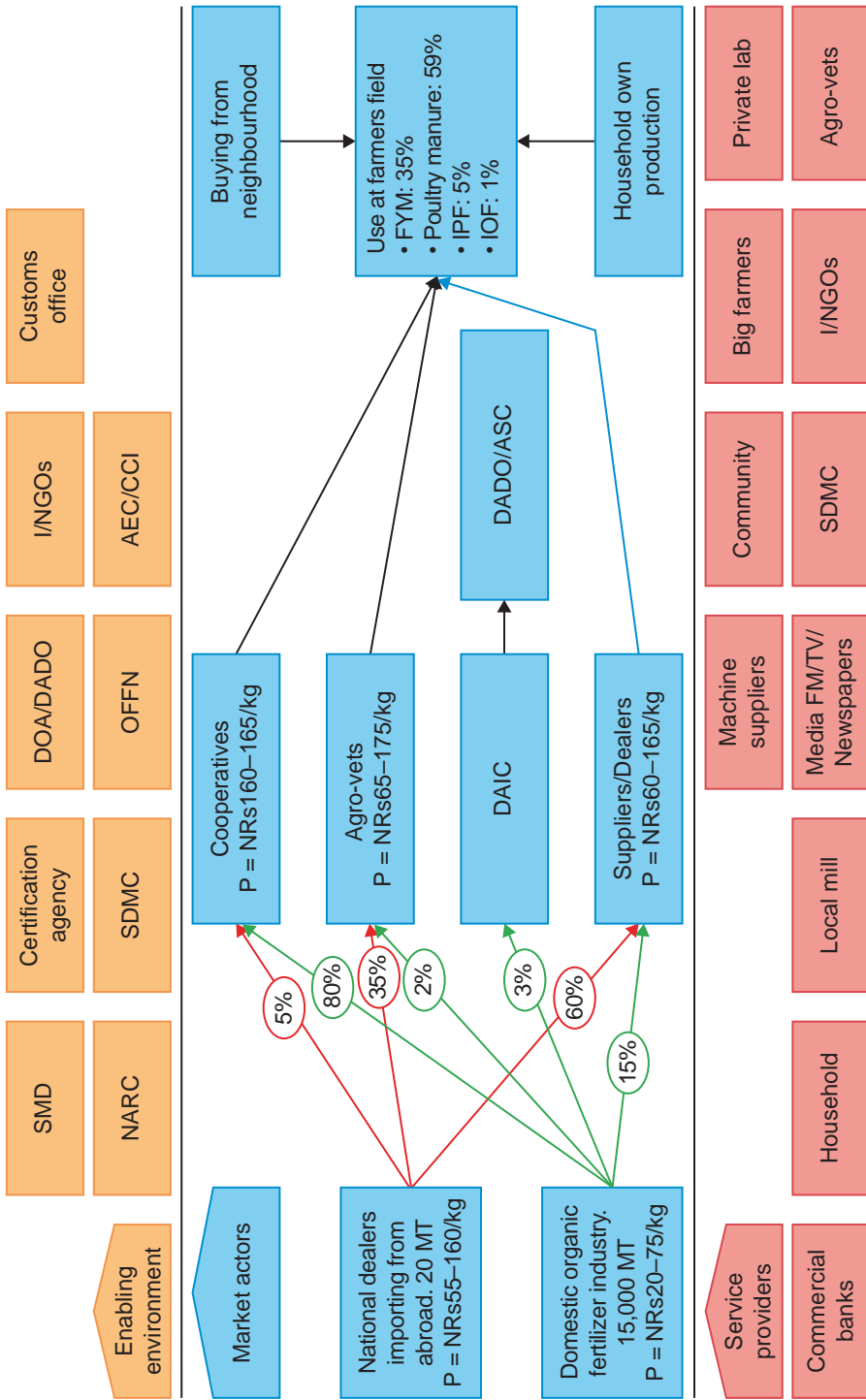


Figure 3 A market map of the organic fertilizer value chain in Nepal
 Note: DOA = Department of Agriculture; SDMC = Subsidy Distribution Management Committee; OFFN = Organic Fertilizer Forum Nepal; AEC = Agro Enterprise Centre; CCI = Chambers of Commerce and Industry; ASC = Agriculture Service Centre; IPF = industry produced fertilizers; IOF = imported organic fertilizers

Table 1 Profitability analysis of vegetable production in different fertilizer-use scenarios in Chitwan (mean, standard error, NRs per *kattha* per year)

<i>Particulars</i>	<i>Organic only</i>	<i>Chemical intensive</i>	<i>Mixed</i>
	<i>Mean</i>	<i>Mean</i>	<i>Mean</i>
Total variable cost (per <i>kattha</i>)	34,775	48,812	35,044
Gross return (per <i>kattha</i>)	53,940	109,616	80,371
Net return (per farm)	19,165	60,804	45,327
Net return (per <i>kattha</i>)	11,344	12,213	25,028
B/C ratio	1.55	2.25	2.29

Note: US\$1 = NRs107 as of September 2016; 30 *katthas* = 1 ha

Table 2 Profitability analysis of vegetable production in different fertilizer-use scenario in Kathmandu (mean, standard error, NRs per *ropani* per year)

<i>Particulars</i>	<i>Organic only</i>	<i>Chemical intensive</i>	<i>Mixed</i>
	<i>Mean</i>	<i>Mean</i>	<i>Mean</i>
Total variable cost (per <i>ropani</i>)	30,740	38,830	37,728
Gross return (per <i>ropani</i>)	75,757	128,465	96,587
Net return (per farm)	45,017	89,635	58,859
Net return (per <i>ropani</i>)	30,138	58,152	32,111
B/C ratio	2.46	3.31	2.56

Note: US\$1 = NRs107 as of September 2016; 20 *ropani* = 1 ha

Chemical-intensive production gave a slightly lower return but had significantly higher costs. Purely organic production was the least profitable (see Table 1).

In the Kathmandu valley, where there is easy access to chemical inputs, strong market demand, and production is more intensive, chemical-intensive vegetable production was the most profitable (see Table 2).

In both locations there was an insignificant difference in market price between organic produce and conventional produce.

In recent years there has been an increase in awareness about the health benefits of organic produce and the negative environmental impacts of intensive chemical use. In this context, some farmers are willing to pay more for organic fertilizer, especially the 'organic only' producers (Figure 4).

This willingness to pay is influenced by farmers' knowledge. The recent study by Practical Action (2016) showed that a large majority of the farmers already perceive a range of benefits from organic fertilizers (see Figure 5).

The study showed there was an issue regarding farmer perception of fertilizer quality. Farmers question the quality of organic fertilizer more than the quality of inorganic fertilizers (see Figure 6). This perception applied to both types of commercial organic fertilizer currently made in Nepal: vermicompost and dust.

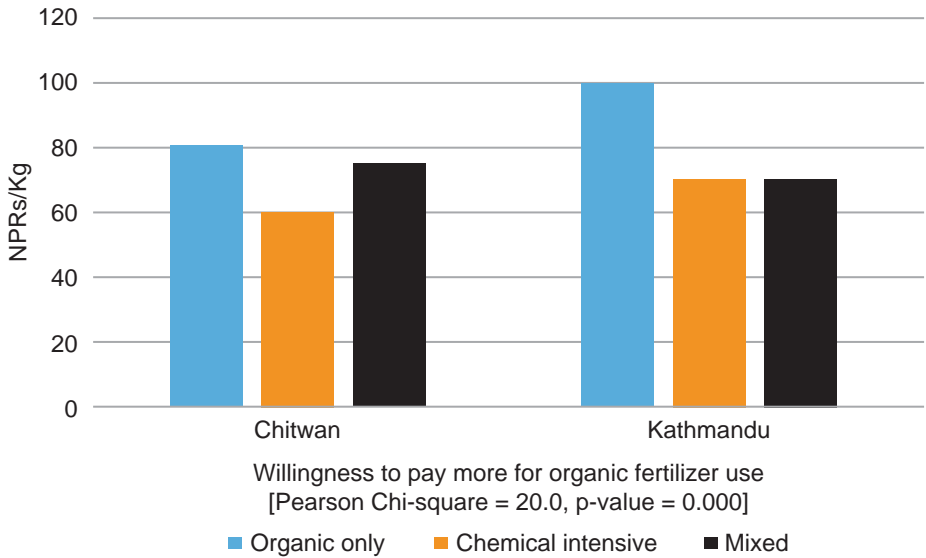


Figure 4 Farmers’ willingness to pay more for organic fertilizer use

Note: US\$1 = NRs107 as of September 2016

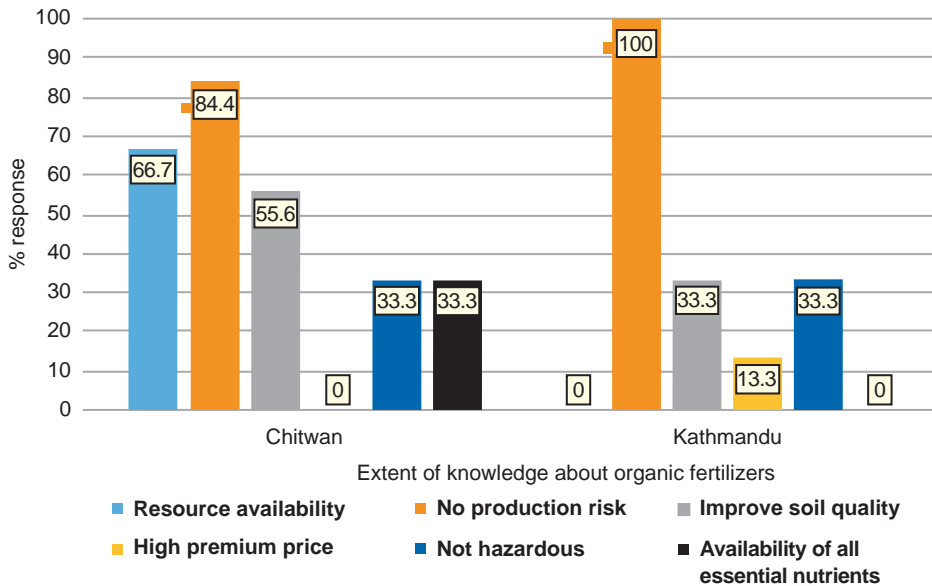


Figure 5 Farmer knowledge of organic fertilizers

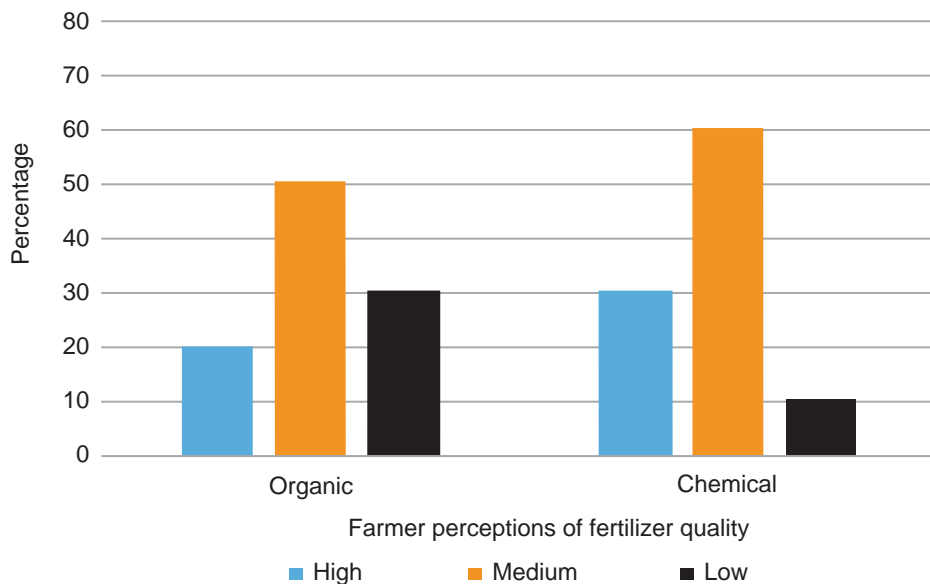


Figure 6 Farmer perceptions of fertilizer quality

Strategies for upscaling the use of organic fertilizers

The Government of Nepal has changed its fertilizer policies many times to enable adequate and smooth supplies to farmers across the country. It has introduced, lifted, and reintroduced many subsidies on chemical fertilizers. Recently it introduced subsidy schemes for organic fertilizers as well. These include the Organic Fertilizer Regulation Procedure (2011), Organic Fertilizer Grant Guideline (2011), and Organic Fertilizer Grant Procedure (2015). Despite such schemes there has been limited growth in the production and use of organic fertilizer.

National plans and policies on chemical fertilizers

The 1995–2015 Agriculture Perspective Plan (ADB, 1995) envisages an increase in chemical fertilizer usage from 31 kg nutrient/hectare (in 1995) to 131 kg nutrient/hectare by 2015. In 1999, a Fertilizer Control Order was promulgated to regulate the fertilizer sector market, which is dependent on imports from India. This resulted in the establishment of the Agriculture Input Company Limited (AICL), a public company to oversee fertilizer quality at the production and retail level. Subsequently, there have been various policies including the removal of price subsidies, deregulation of fertilizer imports, and transport subsidies for selected high and mid-hill districts.

Currently AICL has sole authority to import and distribute fertilizers at subsidized rates. It fixes the price at 20–25 per cent higher than that of India at five import points: Biratnagar, Birgunj, Bhairahawa, Nepalgunj, and Dhangadi.

The price paid by farmers is the price at the point of import plus the subsidized cost of transportation.

Despite the changes in fertilizer policy, the government has found it difficult to meet the demand. The demand for chemical fertilizers is increasing (estimated at 15 per cent per annum) and is usually in deficit (estimated at 46 per cent; AICL, 2013). The deficit has been attributed to limited budgetary allocations, fluctuations of international market price, and illegal trading of sub-standard fertilizers across the long open border with India (Shrestha, 2010). The government devised a plan to establish a national fertilizer industry, but the energy and raw material requirements make it unviable (Thapa, 2006).

National plans and policies on organic fertilizers

The National Fertilizer Policy, 2002 prioritized the promotion of the integrated plan nutrient system (IPNS) for efficient and balanced use of both organic and inorganic fertilizers. To further promote organic fertilizers, the government introduced the Biological Fertilizer Regulation Procedure (2011), the Organic Fertilizer Regulation Procedure (2011), and the Organic Fertilizer Grant Guideline (2011), and allocated NRs50 m (\$466,000) for the promotion of organic fertilizers and establishment of an organic fertilizer factory in 2010.

Organic fertilizer subsidies started in 2011 when the government distributed approximately 5,000 Mt of domestically produced organic fertilizer which comprised approximately 4,200 t of vermi-compost and 800 t of aerobic compost. It was provided with a 50 per cent subsidy on the cost production (Mazumdar, 2012).

The current Organic Fertilizer Grant Procedure (2015) provides the following subsidies:

- A 50 per cent subsidy to farmers on the retail price of organic fertilizer, or NRs10/kg (\$0.09/kg), whichever is lower. Individual farmers can get up to 1.5 t of subsidized fertilizers annually.
- A 50 per cent subsidy to companies on the cost of equipment to manufacture organic fertilizer. To date, 24 organic fertilizer companies have been established, out of which 17 companies have received the 50 per cent subsidy.

Maintaining the quality of organic fertilizer, composts, or soil improvers

A major issue in the organic fertilizer subsector is the maintenance of quality. This includes the procedures for production as well as testing, monitoring, and regulation. Uncertainty over the nutrient (NPK) content is a major obstacle to scaling up production and use.

The availability of raw materials can fluctuate in quantity and quality. At times additives for improving the quality are missing. There are no clear nutrient specifications for organic fertilizers and a lack of accredited laboratories for testing. The system requires companies to be monitored at the national level and fertilizer

to be tested at farm level by inspectors from the District Agriculture Development Office (DADO). However, quality changes with each batch produced (often because of changing raw materials) and the inspection and monitoring is not able to enforce quality.

Research and development for organic fertilizers is lacking. Similarly, there is a lack of information on the efficacy of organic fertilizers, composts, or other soil improvers in different soils and farming systems.

Changing farmer behaviour – creating confidence

Most farmers are not aware that the organic matter content of their soils is low (Ministry of Agricultural Development, 2016). The majority rely on inorganic fertilizers to achieve good yields, which explains the high demand. Many are aware of the need to use farmyard manure or organic fertilizers to maintain or improve soil quality in the long term. However most do not use it in their field crops for two reasons: first, manure and organic fertilizers are not available in sufficient quantity; and second farmers do not trust the quality of organic fertilizers. In contrast, they trust chemical fertilizers because they see them increase yields. Research with farmers has shown that they would buy and use more organic fertilizers *if* the quality was assured (Practical Action, 2016).

Consequences for the organic matter market systems

Research indicates there is growing demand for both chemical and organic fertilizers. Chemical fertilizers are imported, whereas most organic fertilizers are domestically produced. Since it is not financially viable to produce chemical fertilizers in the country, the government has made a rational choice to promote domestic organic fertilizer production.

Given the variable nutrient content of organic fertilizer, and farmers expectation for high yields, soil scientists (and government) have recommended using both organic and inorganic fertilizers – i.e. a semi-organic strategy. Ideally this needs the integration of organic fertilizer (or other soil improvers) into existing fertilizer market systems (production and distribution chains). As the previous market maps show (Figures 1–3), this is not currently the case. Improvement of the fertilizer value chains in Nepal needs innovation and collaboration by a wide range of market systems actors: traders in the value chains, researchers and policy makers, and service providers (e.g. laboratories, certification services, regulators, trainers, and extensionists).

Strategies for promoting growth in organic fertilizer or soil improver enterprises

A recent cost-benefit analysis of existing enterprises indicated that the organic fertilizer business can be profitable (Practical Action, 2016). That said, most are currently running under capacity. It is suggested this is because of a lack of entrepreneurship skills, branding, marketing, and growth strategies within the respective businesses.

Strategies to improve the demand for organic fertilizers by farmers

Farmers are aware of the value of farmyard manure; however, they lack information on the use of commercial organic fertilizer or soil improver products (e.g. the different formulations and types of products on the market). Organic fertilizer and other soil improvers do not work in the same way as inorganic fertilizers. While they directly supply some nutrients, their main benefit is to increase soil organic matter and microbial activity which has a positive effect on the breakdown and release of nutrients and on water retention. Research has shown that a combination of chemical and organic fertilizers can be the most effective (see Table 1; Practical Action, 2016). Knowing this, farmers will pay for organic fertilizers if the quality is assured. Thus, uptake of organic fertilizers by farmers depends upon its availability, affordability, and information on how to apply it effectively.

Strategies to increase the local availability of organic matter to improve soil fertility

Even with successful development of organic fertilizer, compost, or soil improver market systems, there will not be enough organic fertilizer or other commercial products to improve soil fertility everywhere it is needed. The raw materials are simply insufficient to deliver the volume needed. It is therefore important to improve, in parallel, the quantity and quality of organic matter available for agriculture at household level. This is the reason that government also introduced incentives to households to develop compost pits. However that programme has also struggled to reach scale. A more effective approach might be to develop market systems that deliver the equipment (compost bins), consumables (inoculants/additives/worms), or technical knowledge used in making composts (including vermi-composts). It is only with innovation and systems thinking to achieve scale that the technical solutions needed to achieve the SDGs (sustainable production and resilience) can be implemented.

Recommendations***Ensure the quality of commercial organic fertilizers, composts, or soil improvers***

Actions to achieve this could include developing commercial (market) systems to support soil testing – services or kits – so that producers and regulators can monitor the quality of commercial products.

Realistic standards should be established for the different products, recognizing that they do not function in the same way as inorganic fertilizers – i.e. not simply in terms of mineral nutrient levels (NPK, etc.) but also the amount of organic matter.

Government should work with producers to establish a more reliable accreditation and certification system.

Training and extension to disseminate knowledge and build farmer capacity

Farmers, agro-vets, and extension workers from the government, NGOs, and the private sector should be trained in the use of commercial organic fertilizers,

composts, and other soil improver products, as either an essential supplement or an alternative to inorganic fertilizers.

Technical information and recommendations should be developed to support semi-organic (combined organic and balanced inorganic fertilizer) regimes for different crops, soil types, seasons, and agroecological zones in Nepal.

Participatory learning and research

Government agencies should initiate a programme of research with farmers on ways to improve soil fertility using a range of fertilizer types and sources of organic matter (e.g. crop residues, compost, vermi-compost). This should also include agronomic practices so that the fertilizer regime is just part of an *integrated* approach to maintaining soil fertility.

Agencies should also establish a market information system (MIS) for the markets and trade of organic fertilizers and for other actors in the subsector. This information is needed to refine and enable policies to encourage the production and use of organic products in the fertilizer subsector.

Research is also needed with policy makers on how market-based approaches can drive more sustainable agriculture practices.

Similarly, national and international research is needed on:

- how improving levels of soil organic matter is able to improve smallholder productivity, sustainability, and inclusion in the agriculture sector;
- semi-organic fertilizer strategies using commercial organic fertilizer and other soil improver products can contribute towards achieving SDG targets: food security, smallholder livelihoods (poverty reduction), safe and nutritious food, and resilience to the impacts of climate change.

Use market-based approaches to lever a transition in the system (i.e. scale)

Whether tackling the issue of increasing the quantity of commercial organic fertilizer or locally available organic matter, policy makers should look for market-based solutions. For example: markets to support equipment, consumables, or technical knowledge for household composts, or soil testing services or kits to monitor the quality of different products.

Conclusions

It is well known that restoring soil organic matter is essential to achieving improved productivity and sustainability in agriculture. It is also well known that organic fertilizers, composts, or other soil improvers are needed if the intensification that has already been achieved is to be sustained.

Recent work by Practical Action in Nepal has shown that semi-organic fertilizer regimes can be cost effective, and that organic fertilizer, compost, or soil improver producing enterprises can be viable. The same study also showed that farmers will use such products *if* the quality and availability can be assured.

Market-based approaches offer policy makers the opportunity to address the issue of declining soil organic matter at scale. Because of the commercial nature of agriculture, market-based approaches are also needed to enable progress towards agriculture, nutrition, and poverty targets in the SDGs. Insights from the scaling of organic fertilizer markets in Nepal could be useful for influencing policy regarding organic fertilizers, composts, or other soil improvers in other countries.

Annex

For the following Nepalese Government policies, regulations, and guidelines see <www.moad.gov.np> or <www.moac.gov.np>:

- Fertilizer Control Order (1999);
- National Fertilizer Policy (2002);
- Biological Fertilizer Regulation Procedure (2011);
- Organic Fertilizer Regulation Procedure (2011);
- Organic Fertilizer Grant Guideline (2011);
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