Sustainability of Local Food Supply Using New Agriculture Theory in Organic Farming Context in Uttarakhand, India

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The Asian Conference on Sustainability, Energy and the Environment 2015
Official Conference Proceedings

Abstract
The purpose of this research was to explore the changes in livelihood of a group of farmers in Dehradun, Uttarakhand, India that had converted from conventional to organic farming. This research was also based on secondary data using *New Agriculture Theory (NTA)* as a guideline of proper resource management in land and water. The research was inductive and qualitative with *semi-structured face-to-face interviews* carried out with 15 farmers who had converted from conventional to organic agriculture mainly in Dehradun, Uttarakhand. The results of the study show that smallholder organic farms in India achieve the same or even slightly higher yield as conventional farms, using considerably lower nutrient inputs , but with a higher labor input compared to conventional farms. Organic farming has the potential for more sustainable use of natural resources, and reduces overall vulnerability of farm households; nevertheless, the drop of yields due to switching over to organic farming and the opportunistic behavior of some farmers are some of the immediate constraints. It was recommended for government to support more farmers financially in promoting organic farming. to simplify the certification process, to develop market linkages for the benefit of the farmers, and increase awareness of the local consumer about the importance of organic products.

Keywords : Uttarakhand India, Organic farming, New Agriculture Theory, Sustainability

Introduction

The global food crisis has been a concern for many decades. Especially in tropical countries, global warming represents a major threat to food security. The rise of food prices affects the poorest the most. It has been commonly attributed to overpopulation, but that seems to miss the real causes as food levels continue to outstrip demand even in a growing population. As projected by 2020 the world will require 50% more food supplies, as the population will increase. India, a developing country with a big share of the world population, has undergone a remarkable transformation over the past two decades. Faster growth has been brought about by a paradigm shift in economic polices that has opened the economy to foreign trade and markedly reduced direct tax rates and government influence over most investment decisions. The growth rate of average incomes has increased from 1¼ per cent prior to 1980 to 7% by 2006. (Sonnino & Marsden, 2006)

However, due to its agro-climatic regions, India has lots of potential to produce a large variety in agriculture, not least in organic crops. Some part of the country actually already inherited this tradition since ancient times. As a result, this holds promise for the organic producers to tap the market that is growing steadily in the domestic market related to the export market. Currently, India ranks 16th in terms of world organic agricultural land (including in conversion areas) by country in 2012. (FiBL & IFOAM 2014)

Table I : Projected Organic Agriculture India(GoI, 2009)

Total Production	976646 MT
Total quantity exported	37533 MT
Value of total export	Rs. 106 Million USD
Total area under certification	2,8 Million Ha
Number of farmers	1.95.741
Export Value	100.4 Million USD
Share of exports to total product	4 % approx.
Increase in export value over previous year	30 % approx.

Nevertheless, number of smallholder farmers are low and marginal cultivating areas of less than two hectares. Increasing land fragmentation, diminishing natural assets, high costs for external farm inputs, indebtedness, and pesticide-related health issues have threatened the livelihoods of many farming families (NCF 2006, MSSRF & WFP 2004, Ninan & Chandrashekar 1993). To support this movement, organic farmers groups and non-government organizations have formed an organic agriculture movement that supports organic farmers, establishes organic channels and tries to influence policies. Eventhough, there is plenty of research to support organic farming approaches; there is still a lack of scientific investigation into support strategies that meet stakeholders needs. Therefore, the aim of this research was to explore the changes in livelihood of a group of farmers in Dehradun, Uttarakhand India that had converted from conventional to organic farming. The research will use *New Agriculture Theory (NTA)* as a guideline of proper resource management in land and water (Royal Speech, 1994).

This theory is an alternative sustainable model to corporate producers and consumers that are separated through a chain of processors, distributors and retailers (Sonnino & Marsden, 2006)

There are two challenges for Indian agriculture for improving quality of life to alleviate poverty. One of the challenges relates to crop diversification away from food grains. More generally, a move towards diversification into fruits, vegetables and floriculture requires adoption of scientific methods of farming and investment in logistics. It also inevitably implies greater risks than those of producing food grains for assured markets at prices determined by the government. Moreover, after the implementation of green revolution technologies as the major production system in the world, there is growing evidence that the Green Revolution has, at its worst, increased inequality, worsened absolute poverty, and resulted in environmental degradation (IFPRI, 2002).The biggest revolution in the Indian rural sector will come from the revolution in retail trading which is on its way.

A second set of challenges relates to the availability of water for Indian agriculture. Inadequate and ineffective irrigation and a declining water supply required policies that encourage conservation of water and investments in water management. Correct pricing of water is crucial as a policy which moves away from giving free electricity to farmers because the latter only encourages excessive use of water for farming. While agriculture cannot be the engine for growth in the years to come, boosting agricultural growth and fostering linkages with the industrial and services sectors is crucial not only for raising the farmers' returns on high value agriculture but also for the sustainability of the growth process.

Using the basis of relations between "*human-economy-nature*" for sustainable development, organic farming will unite all agriculture systems that consider the balance of ecology, social issues and economy in agricultural production. The following practices will ensure sustainable agriculture: optimization of land use and crop management; efficient use of available organic fertilizing resources; agro-technical methods to protect crops from weeds; crop rotation; soil-protecting technologies for planned chemical land reclamation; preservation of agricultural and biological diversity at farms and its efficient utilization; stabilization of agro-landscapes through a uniform system of field-protecting forest belts; facilitation of proper use and preservation of water resources; usage of renewable resources; a harmonious balance between crop and animal production through integrated farming; and utilization of indigenous technical knowledge. (Kaswan, 2012)

Furthermore, the intensive use of synthetic chemicals to boost production has proved unsafe for nature. When there is a shift towards massive usage of agro chemicals in modern farming by many developed and developing countries, there are various effects on the water quality, soil nutrition, food and environment. Kaswan (2012) further summarized some harmful impacts due to chemical fertilizer. Application of nitrogen fertilizers such as *urea* and *ammonium sulphate* to soils produces acid by two processes. First, the natural process of oxidation of ammonia ions to nitrate ions releases acids. Part of the acids produced is neutralized by alkaline ions released by plants during the subsequent uptake of the nitrate ions. Secondly, since nitrate ions are not strongly absorbed by the soil they are liable to leach or move down through the soil. The negatively charged nitrate ions carry positively charged basic cations such as

Ca, K, Mg and Na in order to maintain the electric charge on the soil particles. A high nitrate concentration indicates likely presence of harmful bacteria as well. In condition, to high enrichment, oxides of N may occur in a state known as methaemoglobinema (*blue babies*), which generally affects the infants under six months of age. Repeated heavy dose of nitrate on ingestion is likely to cause carcinogenic diseases. Apart from this, over-use of N fertilizers leads to dwindling of earthworms from the particular area, and their absence means a loss of soil fertility. Also, contamination of soil by heavy metal through fertilizers such as cadmium from phosphate fertilizers has caught the attention of environmentalists (Kostial, 1986). Fertilizers contain heavy metals as impurities. The application of rock phosphate or its produce to soil always implies the addition of significant amounts of lead and cadmium into the soil. Using organic fertilizers can add more nutrition and cadmium to soil than mixed fertilizers (Arora et al., 1995). It can also cause the *eutrophication* of water as a process of enrichment of surface water bodies like lakes, reservoir and streams with nutrients. Nutrient enrichment of water bodies results in intense proliferation and accumulation of algae and higher aquatic plants in excessive quantities that can result in detrimental changes in water quality and can significantly interfere with the use of water resources.

Based on Surekha et al (2009) India has competitive advantages in the world markets due to low production costs and availability of diverse climates to grow a large number of crops round the year. The major products of organic farming in India are listed in the table below :

Table II : Major Organic Crops in India

Cereals	Wheat, Rice (Basmati)
Spices	Cardamom, Black pepper, White Pepper, Ginger, Turmeric, Vanilla, Mustard, Coriander, Clove, Cinnamon, Nutmeg, Chili
Beverages	Tea, Coffee
Pulses	Red gram, black gram
Fruits	Mango, Banana, Pineapple, Passion Fruit
Vegetables	Okra, Aubergine, Garlic, Union, Tomato, Potato
Oil Seeds	Sesame, Castor, Sunflower, Groundnut
Others	Cotton, Cashew nut, Herbal Extracts

Source : Agri. Stat at Glance. (2008)

Sustainability Indicators

Principal sustainability concepts cover environmental, economic, and social aspects. Only a small part of the literature on sustainability measurement integrates all aspects, most cases focus on one of three aspects (Singh, Murty, Gupta, & Dikshit, 2009). Both sustainable agriculture and sustainable farming criteria cover environmental and social issues. But this study focuses on smallholder farmers, which are in the upstream part of the supply chain; therefore, some criteria in sustainable farming are beyond the scope of this discussion. Hence, sustainable agriculture criteria are chosen only.

There are several sustainability indicators related to *Sustainable Agriculture*. However, they are either very restrictive or beyond the scope of this work, except the *Indicator of Sustainable Agricultural Practice (ISAP),* constructed by Rigby, Woodhouse, Young, and Burton (2001). It is designed for farm level and the need for data collection is minimized. A total ISAP score is obtained from four criteria in sustainability, namely: (1) minimizing off-farm inputs; (2) minimizing inputs from non-renewable sources; (3) maximizing use of (knowledge of) natural biological processes; (4) promoting local biodiversity or environmental quality.

The *International Federation of Organic Farming Movement* or IFOAM (2005) also listed the advantages of organic agriculture as follow:

- *Principle of Health*, organic agriculture is intended to sustain and enhance the health of soil, plant, animal and human beings as one and indivisible. In view of this, it constrains the use of fertilizers, pesticides, animal drugs and food additives that may have adverse health effects.
- *Principle of Ecology*, organic agriculture should be based on living ecological systems and cycles, work with them, emulate them and help to sustain them. Organic agriculture should attain ecological balance by means of utilizing locally available resources.
- *Principle of Fairness*, organic agriculture should build on the relationships that ensure fairness with regard to the common environment and life opportunities. Fairness characterized by equity, respect, justice and stewardship of the shared world, both among people and their relations to other beings.
- *Principle of Care*: Organic agriculture should be managed in a precautionary and responsible manner to protect the health and wellbeing of current and future generations and the environment. Practitioners of organic agriculture can enhance efficiency and increase productivity, but this should not be at the cost/risk of jeopardizing health and well-being.

2. Methods

2.1 Study Area

This research focuses on Uttarakhand, in the Western Himalayan Region of India. It has five distinct agro-ecological sub-regions divided mainly by altitude, varying from 300m to 3600m. Wheat, rice and sugarcane are the major crops found in Upper Dun, Bhabar; while in lower-lying Shivaliks also wheat, rice, finger millet, barnyard millet, amaranth, and maize crops are cultivated. Middle Gharwal-Kumaon and Upper Gharwal-Kumaon sub-regions with altitudes of 1200-1800m and 1800-2400m, respectively, grow wheat, rice, finger millet, jhangora, cheena, potato, barley, and chaulai. Various pulses (Masur and Kulat) are intercropped during early winter and after the rainy season. Dry and wet rice, taro, pumpkins, beans, corn, ginger, chili, cucumbers, leafy vegetables, and tobacco are also grown. Uttarakhand's geographical area is 53,483 square kilometres, of which 65 percent is forest land and only 776 thousand ha (15 percent of the total land area) is cultivated. The irrigation of 44.6 per cent of cultivated area comes from canals and tube wells. Over hundreds of years, many slopes have been cut into field terraces, a common characteristic agriculture around the world. The region's farmers have also developed advanced manure, crop rotation, and intercropping systems. Most land on the slopes remains not irrigated.

Irregularity of rainfall and worsening droughts have mostly disadvantaged the farmers. Thus, the green revolution in India has imposed the use of synthetic agrochemicals such as fertilizers and pesticides; combined with adoption of nutrient-responsive, high-yielding varieties of crops this has boosted the production output per hectare in most cases. However, in the long run the increase of production has slowed down, has declined productivity, and has affected the soil nutrients and human health as well. In addressing this problem, one organic farming organization in Uttrakhand named Navdanya is trying to rebuild self-reliance agriculture through organic farming practices. Populations who are living in rural areas thus make food available for their own consumption. These farmers were not dependent on the market, contrary to what we normally see in modern agriculture. Farmers re-learned the old skills and now grow varieties suitable to their land, rather than being dictated by the companies. The perversion of the green revolution is that the environment was modified to fit the plant. The organic farm, instead, grows local, indigenous, and climate resilient varieties. Organic farmers grow a variety of crops and maintain livestock in order to optimize use of nutrients and the space between species.

In Uttarakhand, a majority of farmers using fertilizers reverted back to organic ways of farming. It is important to recognize what are the main motivations for farmers to adopt organic. Based on Pratap (2009) their motivation is more on to stay organic rather than a choice to start organic since they already practiced organic long time before. About 40% of the farmers cited premium prices as motivating factor to stay organic and further improve their organic farming and get certified. Although there are no single reasons that can be attributed to the adoption of organic farming, it is a fact that more farmers grow organic because of the awareness of a market for organic products, because of the premium product price, and because of health hazards of chemical use in farming.

2.2 Data Acquisition and Processing

This research is based on *secondary data*. Information from literature on the historical evolution of the organic farming and the progress it has made both in India and abroad have been collected from sources like the websites of the *International*

Federation of Organic Farming Movements (IFOAM), books and periodicals, and newspaper reports. These have been liberally used for the preparation of the paper. The research was inductive and qualitative, although some quantitative data was used to support qualitative findings. Issues that were not considered before were able to emerge, and aspects that could not be quantified were explored. *Semi-structured face-to-face* interviews were carried out with 15 farmers who had converted from conventional to organic agriculture mainly in Dehradun, Uttarakhand. They were asked about income sources, land ownership, their motivations for adopting organic farming, factors that had supported the conversion, and their perceptions of what effects the conversion had on their assets, their livelihood outcomes, including income, health, nutrition and self-sufficiency, their vulnerability, and their external environment, including policies, institutions, and processes. The interviews were held in the farmers' fields and/or in their homes providing the opportunity to gather additional information by observation. Discussions with informed individuals/institutions, agriculture experts, social scientists, consumers, market intermediaries, Accreditation and Certification Agencies, NGOs and farmers were also held.

Table III : Socio Economic Profile of farmer

Farm characteristics	**Details**
Social parameters	Caste, education and age of the farmer, house type, family type, number of family members
Land holding	Own land, leased land
Crop rotation pattern	Area under main crops; crop rotation patterns
Agricultural equipment	Equipment for soil cultivation and transportation
Cattle	Stocks of cows, bullocks, buffaloes, goats
Incomes (other than from crops)	Milk sales, off-farm income
Agricultural labour	Family own labour (male, female), permanently hired labour
Irrigation systems	Micro-irrigation systems, well

2.3 Analysis

This research used *New Agriculture Theory (NTA)* as a guideline of proper resource management in land and water This theory is an alternative sustainable model to corporate producers and consumers that are separated through a chain of processors, distributors and retailers (Sonnino & Marsden, 2006).

The main purpose is to help farmers to be more self-reliant and living harmoniously with nature within society through a holistic management of their land. This concept has three levels of development: (1) household level; (2) community level; and (3) national level (Wibulswasdi, Piboolsravut, & Pootrakool, 2010).

The purpose of first level is to create *self-reliance* and *self-sufficient* at the households level. Assuming total area required is 2.4 hectares on average, it should be divided into four parts in a ratio of 30%, 30%, 30%, 10%, which may vary depending on geographic condition. Three portions of 30% each are for rice cultivation, fruits and vegetables, and for a pond. The remaining 10% is for housing and other activities. This level provides diversification that is effective for insect and weed control, water management, and soil management. So farmers' needs in food and nutrition are met sufficiently by themselves. They can also sell exceeding products in local, face-to-face, to earn extra income.

The second level is the community level, that aims to create sufficiency through collaboration among community members. Each household can share either different resources or amount that exceeds its need. Collaboration advances community to achieve economies of scale and scope so that costs of living are reduced and income is increased. For examples of collaboration, co-op based production, and money-saving groups. This is related to a spatially proximate format.

The third level, national level, is a concept to create value-chain by collaborating with others outside the community. Such collaborative activities should strengthen agriculture production or financial safety in the community. For instance, creating direct sales channels, raising funds and seeking funds by reaching out to banks, and other sources outside community.

The process from farm to plate of this theory is similar to a short food supply chain in three formats (Marsden, Banks, & Bristow, 2000), namely: (1) face-to-face: consumers buy a product direct from the producer; (2) spatially proximate: products are sold through local outlets in the area and consumers are immediately aware of its local nature; and (3) spatially extended: products are sold to the outside local area consumers who have no or little knowledge of the area.

3. Results

3.1 Conversion from Conventional to Organic Farming

Interviews with farmers who practice organic farming, most have sufficient basic knowledge about organic agriculture. Their awareness that sustainable agriculture requires long-term vision reflects their differences with farmers who are still farming with chemicals. Farmers largely convert to organic farming because of the uneasiness experienced with the existing agriculture system, which is predominantly based on chemicals. Some farmers perceive chemical agriculture to be a health hazard for them.

Yields in irrigated farms may go down during the conversion period from conventional to organic farming because the crop yields are boosted by artificial fertilizers and it takes time for the natural soil fertility to be restored. However, after conversion yields will be equal, if not higher than the yield during the conventional farming. In the rain fed farming, the situation is different; yields are significantly lower and thus, the difference in yields between the conventional and conversion period is narrow. Although there are only a few comparative yield studies at both global and national levels, certain studies have provided a broad indication about the productivity of organic farms vis-à-vis conventional farms. Conversion from the

traditional low-external input system of cultivation rarely results in lower yields. However, when switching from external-input-intensive forms of agriculture, the yields may decline significantly, at least during the initial years of conversion, until the natural soil and fertility are sufficiently restored. (Kasturi, 2007). In relation to the cultivation cost, this argument is supported by a study done by Dr. Joginder Singh (2009) due to organic products of inorganic input, as the cost of cultivation showed decline in most crops in Uttarakhand as shown below :

Table IV : Cost of Cultivation Organic Vs Inorganic Crops (Rs/Acre)

Crops	**Inorganic**	**Organic**	**% Decrease**
Basmati	8390	7690	8,34
Non Basmati	7800	7600	2,56
Wheat	7400	6500	12,16
Finger Millet	3150	2800	11,11
Maize	4200	3800	9,52
Barley	3600	3320	7,78
Sorghum	3150	2800	11,11
Sugarcane	14500	13740	3,90
Peas	10070	10870	-7,94
Tomato	9400	9400	0,00
Potato	8500	8200	3,53
Cauliflower	9180	9980	-8,71
Ginger/Turmeric	5400	5500	-1,85
Chilli green/red	8600	7800	9,30
Tulsi green	3700	3700	0,00
Coriander Green	8350	7800	6,59
French beans	4500	4000	11,11
Soybean	4500	4000	11,11
Kidney bean	4500	4000	11,11
Mustard	4200	4500	-7,14
Union	8350	8450	-1,20
Eddoes (arbi)	5900	5700	3,39

3.2 Soil Fertility

Based on Shiva (1992), biological products not sold on the market but used as internal inputs for maintaining soil fertility were totally ignored in the cost-benefit equations of the green revolution. They did not appear in the list of inputs because they were not purchased, and they did not appear as outputs because they were not sold. So basically green revolution technologies created the perception that soil fertility is produced in chemical factories, and agricultural yields are measured only through marketed commodities. Nitrogen fixing crops like pulses were displaced (Rupela, 2007). Organic manures not only supply nutrients to crops and improve the soil texture in dry lands but also act as mulches. They protect crops against adverse temperature effects, improve seed germination, increase water retention capacity of the soil and create the right micro-climate for the development of beneficial soil microbes (Sharma, 1991; Reddy, 2010a).

3.3 Livestock

In integration with agriculture, livestock has a profound influence on its sustainability. Apart from providing additional income, livestock generates employment in the rural area itself. Livestock contributes directly to agriculture by producing manure and influencing the availability of organic carbon to soil. It contributes indirectly through its influence on income of the households. Integration of livestock and crop production, or mixed farming, allows the use of animal manure to increase soil fertility. Farmers recognize the benefits of using manure, and with the relatively high costs of mineral fertilizers, manure could play a greater role in maintaining soil fertility (Powell and Williams, 1995). Of the farmers interviewed, one farmer on average has two cows and one buffalo; some may have a goat. The livestock component of the farming system is crucial to maintain soil fertility, a supply of draught power, and food for the family (Reddy, 2001). The nutrient management system has become more closed with the weakened traditional linkages between forest and livestock (Turton *et al*., 1997). Increased income through livestock strengthens the capacity of a household to invest in productivity also enhancing measures through the purchase of off-farm inputs (George, 1996). Earnings from the landholdings of a majority of marginal, small and semi-medium farmers alone are not adequately sufficient for the household round-the-year and livestock rearing provides an alternative to these smallholders (Joshi and Jha, 1981).

4. Discussion and Conclusion

4.1 Organic farming improves farmers' livelihoods

The results of the study show that smallholder organic farms in India achieve similar or slightly higher yields as conventional farms, though nutrient inputs are considerably lower; and require more labour input compared to conventional farms. With lower production costs and a 20% organic price premium, gross margins for instance cotton are thus substantially higher than in the conventional system. Even if the crops grown in rotation with cotton cannot be sold with a price premium, conversion to organic farming can lead to a substantial increase in farm incomes. Hence, organic farming in a setting with assured price premium can significantly improve the livelihoods of smallholders. Most farmers in Uttarakhand shares that crops and livestock by products get better utilized in organic farm plugging back of residue to improve soil health and as pesticide from environmental angles. About 40% of the respondents expressed that there is a better economic use by farm products while the rest of them are on the view of remained the same.

Table V : Factor contributing to direct Economic Impact of Organic Farming

No	Parameter	Plain Area	Hilly Area
1	Yield effect (Rs/Acre)	-3022	-629
2	Price Effect (Rs/Acre)	2038	1899
3	Cost Effect (Rs/Acre)	790	268
4	Area effect (Rs/Acre)	757	583
5	**Total gain (Rs/Acre**	762	2121
6	Farm Size (acres)	7,6	3,2
7	**Per farm gain (Rs)**	5791	6787
8	Current Farm Income (Rs/Acre)	20833	17772
9	Total Farm Income (Rs/Annum)	158331	56870
10	**% Increase in Income**	**3,80 %**	**13,55%**

4.2 Organic farming has the potential for more sustainable use of natural resources

In the perception of most organic farmers, soil fertility significantly improved after conversion. To quantify the impact of conversion to organic management on soil fertility and water use, long-term field trials are likely to be more suitable. If organic management actually improves soil structure and increases water retention, this can reduce the crop's susceptibility to drought. As water is the main limiting factor for agricultural production in many semi-arid regions, this aspect deserves further investigation.

4.3 Organic farming reduces overall vulnerability of farm households

As organic farming involves less production costs and generates higher incomes, farmers are less prone to become indebted. For example, vulnerability of cotton farms – both for organic as well as for conventional farms – is highest when it comes to changes in cotton world market prices. To reduce the effect of drops in cotton prices, organic cotton projects could guarantee minimum purchase prices and develop organic marketing options for the main rotation crops. In the long term, conversion to organic farming can significantly reduce vulnerability of farm households as the additional income enables them to invest in better irrigation systems (e.g. drip irrigation) and to diversify their income sources (e.g. dairy farming or small-scale businesses).

5. Discussion

It remains an argument whether India's high population is reflected in its food scarcity. The argument is that people are hungry not because the population is growing so fast that food is becoming scarce, but because people cannot afford it. Food may be scarce, but it is international trade, economic policies and the control of land of agriculture that have lead to immense poverty and hunger. Therefore, poor access to food is one of the reason; not food scarcity due to over-population. Yet,

problems in Indian agriculture are either related to stagnant productivity levels requiring heavy doses of research and improved practices of water management and cultivation, etc., or those that are directly the result of government policy design, e.g., spiraling input subsidies for agriculture which have eaten into government's capacity for public investment, inefficient marketing systems, and a highly inefficient public distribution system at subsidized prices for consumers.

The organic farmers in this study perceived that the conversion from conventional to organic agriculture had improved their livelihoods in a range of ways. They pointed out that over the long term the conversion had improved their net-farm incomes, reduced the risk of pesticide poisonings, lead to more self-sufficiency, improved food safety and reduced vulnerability, and improved the access to networks supporting knowledge exchange and political participation. However, risk and uncertainty related to the conversion period, such as temporarily declining yields and the lack of experiences and information, were mentioned as major constraints preventing particular asset-poor households from adopting organic farming. To date, lack of institutional extension and educational material on organic agriculture require farmers to rely on their own knowledge and farmers' networks.

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