International Journal of Agricultural Policy and Research Vol.6 (6), pp. 83-89, June 2018
Available online at https://www.journalissues.org/IJAPR/
https://doi.org/10.15739/IJAPR.18.010

ISSN 2350-1561

Review

Sustainable development goals and food security: Incorporating innovative farming techniques in times of Boko Haram crisis in Nigeria

Received 27 April, 2018 | Revised 5 June, 2018 | Accepted 14 June, 2018 | Published 23 June, 2018

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At the end of the Millennium Development Goals (MDGs), food security remained a major challenge to Nigeria which has to be overcome by 2030 following the formulation of Sustainable Development Goals (SDGs). Nigeria still depends on import of major food staples like rice. The fact that the country is going through economic recession has raised the poverty level which makes access to food more challenging. There is also the insecurity problem as a result of insurgence by extremist groups like the Niger Delta militants in the South-south, Boko Haram in the North-east and clashes between herdsmen and farmers. These factors pose risks to achieving food security in the Nation which is vital for national development. Boko Haram has drastically reduced food production as farmers fled their homes and abandoned their farms out of fear with majority of displaced people still in camps and residences of family and friends in the urban areas, the need to find innovative ways to increase food availability in the Internally Displaced Person (IDP) camps cannot be overemphasized. There is therefore an urgent need to identify innovative farming techniques as focused in this paper, which can be applied to increase food availability and provide means of livelihood to the Internally Displaced Persons (IDPs). The techniques explored will require to be researched on and field tested for successful adaptation.

Key words: Sustainable development goals, food security, Boko Haram, insurgency, risk factors.

INTRODUCTION

One of the goals of the Millennium Development Goals (MDGs) is to achieve food security by 2015, though this has not been achieved as almost 1 billion people still suffer from hunger and almost 2 billion are under-nourished according to Food and Agriculture Organization (FAO,2002). The Sustainable Development Goals (SDGs) is an expansion of the Millennium Development Goals that is aimed at transforming the world over the next fifteen (15) years. It has seventeen goals as against eight for MDGs. Two of the goals are eradicating poverty and providing food security for all (Elver, 2015). Food security may be understood as the access by all people at all times to food sufficiency for a healthy life while food insecurity is the lack of access to enough food leading to poverty. Food security is dependent on the sustainability of food supply while poverty is regarded as the root cause of food insecurity. Nigeria is one of the countries which failed to achieve the MDGs as hunger, malnutrition and poverty among other challenges still remains widespread across the country. First, the population issue; Nigeria is the most populous country in Africa with a current population of about 170 million (as at 2012) and a growth rate of 3.2 % per annum (Okpi, 2013). It is projected that by 2050, world population will reach nine (9) billion according to the Food and Agriculture Organization (FAO, 2002). The population of Nigeria has been projected to reach 440.4 million by mid-

2050 as released by the Population Reference Bureau in the 2013 World Population Data Sheet (Okpi, 2013). This will place Nigeria as the third most populous country in the world just behind India and China who will have a population of 1.65 billion and 1.31 billion, respectively (Okpi, 2013). Most farmers in Africa live in rural areas and cultivate small plots of land. Yields are poor due to so many limiting factors including inadequate fertilizer, improved seed varieties, pesticides and poor knowledge of appropriate cultural practices. Other factors include poor budgetary allocation to the sector, inadequate research and extension services, drought, desertification, high temperature, flood, non-fertile soil, postharvest losses and inadequate or inadaptable agricultural mechanization technologies. Unreliable rainfall pattern and low nutrient soils are the major causes of crop failure, although irrigation can be used to water crops in dry season, it is too expensive for the small-scale farmers. There is also the factor of climate change that may account for the late rains, floods and high temperature; and which has led to changes in the phenology of plants (Ong, 2003). In recent times the problems of urban migration and insecurity due to insurgence of extremist groups and militants like *Boko Haram* (BH) in North-eastern Nigeria and the *Niger Delta militants* in the South-south respectively, have disastrous effect on agriculture. People fear to move outside the protected areas because of possible attacks by insurgents while farmers fear attacks while in the farm cultivating crops or grazing livestock Similarly, according to Tari et al. (2016) small-scale farmers, herders and fishermen are the hardest hit. Media reports from internally displaced persons (IDPs) camps suggests that some of the IDPs survive on a meal per day, resulting in cases of malnutrition. There is therefore, a need to mitigate the impact of the crisis in a way that IDPs can have something to do, as well as provide a means to improve their livelihood. This paper, while considering the case of BH as a risk factor to food security, also explores some farming techniques that can be experimented in IDP camps, personal residences, and backyards as strategies to ease the burden on government, donors, families and friends in terms of food security. Different actors need to come together to contribute towards reducing the impact of insurgency on food security. The ideas presented in this paper needs to be researched upon to enable their adaptability for the benefit of the community and the nation.

The aim of this paper therefore, is to consider the case of BH insurgency as a risk factor to food security with a view to providing suggestions on alternative, innovative farming techniques from international examples which can be developed and implemented as part of measures to improve food provision at IDP camps and a means of livelihood to the IDPs.

Sustainable development goals

During the 1980s the idea of sustainability was fundamentally embraced by the ecological movement at a time when environmental pollution had become an issue of increasing importance. The term was also introduced into political debate by the Brundtland-Commission in 1987 (Umar and Haruna, 2015). This commission stated that the term sustainable development should be a matter of general concern for the whole society. The concept of sustainability contains the following three aspects:

a) Ecological sustainability
b) Economic sustainability
c) Social sustainability.

The concept of ecological sustainability has appeared frequently in official documents over the last 15 years, e. g. in the Convention on the Climate and the Kyoto-Protocol (FAO, 2013). Sustainability opposes the wasting and short term plundering of resources, and promotes the respectful and responsible treatment of human resources with consideration given to future developments and generations (Umar and Haruna, 2015).

World leaders converged at a millennium summit at the United Nations Headquarters in NewYork in 2000, to discuss global problems which includes food security, at the end of the summit, they agreed to work together to find a lasting solution to the problems. During the summit, poverty was considered to be the root cause of food insecurity, it was then agreed to reduce global poverty rate to half by 2015. This led to the formulation of Millennium Development Goals (MDGs). At the end of 2015, the MDGs were expanded to 17 point Sustainable Development Goals and this includes eradicating hunger and poverty. The Sustainable Development Goals (SDGs), officially known as *Transforming our World: the 2030 Agenda for Sustainable Development* is a set of seventeen aspirational "Global Goals" with 169 targets between them. It is spearheaded by the United Nations and it involves its 193 Member States, as well as global civil society groups. The highlight of the seventeen SDGs (https://en.un.org/sustainable-development-goals) is given in this section.

1. **No Poverty** - End poverty in all its forms everywhere.
2. **Zero Hunger**- End hunger, achieve food security and improve nutrition and promote sustainable agriculture.
3. **Good Health and Well-being** - Ensure healthy lives and promote well-being for all at all ages.
4. **Quality Education** - Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
5. **Gender Equality** - Achieve gender equality and empowers all women and girls.
6. **Clean Water and Sanitation** - Ensure availability and sustainable management of water and sanitation for all. **Affordable and Clean Energy** - Ensure access to affordable, reliable, sustainable and modern energy for all
7. **Decent Work and Economic Growth** - Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

8 **Industry, Innovation and Infrastructure** – Build resilient infrastructure, promote inclusive and

sustainable industrialization and foster innovation.

8. **Reduced Inequalities** - Reduce income inequality within and among countries.
9. **Sustainable Cities and Communities** - Make cities and human settlements inclusive, safe, resilient and sustainable.
10. **Responsible Consumption and Production** - Ensure sustainable consumption and production patterns.
11. **Climate Action** - Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy.
12. **Life Below Water** - Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
13. **Life on Land** - Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
14. **Peace, Justice and Strong Institutions** - Promote peaceful and inclusive societies for sustainable development.
15. **Provide access to justice** - for all and build effective, accountable and inclusive institutions at all levels.
16. **Partnerships for the Goals** - Strengthen the means of implementation and revitalize the global partnership for sustainable development.

These seventeen set of goals are expected to be used by United Nation's member states to frame their agenda and policies over the next fifteen years.

Food security

Food security is fundamental to all nations because no nation will like to see its people poor and hungry. It is thus the driving force to national development. The term "food security" was defined as "when all people, at all times have, physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life". That is, food security exists when all members of household at all times have access to enough food for an active and healthy life (FAO, 2006). Another definition also given by FAO is, "food security means that food is available at all times ,that all persons have access to it , that it is nutritionally adequate in terms of quality, quantity and variety and that is available within a given culture (Ahmed et al., 2007). There are thus three basic components to food security and these are; availability, access and utilization.

Sustainable food security is a global problem considering the increasing global population which is projected to reach nine (9) billion by 2050 (Okpi, 2013). The challenge of food security is more serious in developing countries and Nigeria is no exception. Several efforts have been made in Nigeria in the past to ensure food security, but most of these efforts are yet to yield any result. Shortages of essential agricultural commodities remain perpetual as evidenced by continuous increases in food prices, and higher import bills. Nigeria is still importing food and according to the Minister of Agriculture, Chief Audu Ogbeh, Nigeria spends 20billion USD annually on food import (Anwar, 2016). Some of the efforts made in the past include, the National Accelerated Food Production Program (NAFPP) launched in 1960, Operation Feed the Nation, launched in 1976, Green Revolution Program launched in 1980, and Agricultural Transformation Agenda (ATA) launched in 2011. There were also the agency-based intervention programmes which include; National Agricultural Land Development Authority (NALDA), River Basin Development Authorities (RBDAs), Agricultural Development Programmes (ADPs), Directorate of Food, Road and Rural Infrastructure (DFRRI), National Center for Agricultural Mechanization (NCAM), etc (Manyong et al., 2005). Yet, while these programmes have recorded major successes, many limitations including lack of continuity have hindered the much desired goal of achieving self-sufficiency in food production (Manyong et al., 2005). In Nigeria, about 70% of the population are farmers as reported by Okolo (2004) and even though farming is subsistence on small farms, it produces 80% of total food production in Nigeria. The farmers depend on agriculture as their only source of food, and often their main source of income. Thus, agriculture holds the potential to food security and to stimulate wider economic growth once adequate attention is given to the sector. In the face of the numerous challenges that threaten achievement of food security including insurgency, militancy and clashes between herdsmen and farmers, there is a need to device alternative farming methods that can boost food production to feed the population and reduce the level of hunger, malnutrition and poverty.

One of the main global challenges of this century is how to ensure food security for a world growing population whilst ensuring long-term sustainable development. Agriculture has changed over the years and is facing multiple challenges due to problems associated with water stress, soil degradation, global climate change, genetic engineering and loss of manpower necessary for agricultural development due to urban migration. People tend to migrate from the rural to urban areas for better opportunities and the migration is highest among the youths of ages between 15 – 30 years, who happen to be more productive. This causes a heavy drain on the supply of human family labour (Iruonagbe, 2009). The reason for the migration could be because farming is not lucrative as the gain from agriculture is meager, due to many reasons including drudgery associated with traditional farming practices, owing to the high cost or inadequate agricultural machineries and tools, migration resulting from fear of insurgents and farmers – herders crisis, poor pricing of the farm produce, poor transportation, and lack of good storage facilities, etc. This results in reduction of agricultural production, because a large proportion of the people have abandoned farming and taken up other non-agricultural jobs in the cities. The risk posed by rural – urban migration is that the resulting loss of manpower necessary for agricultural development leads to more poverty and food

insecurity. Rural-urban migration thus, becomes a risk factor to food security. Agricultural research has also undergone changes and will continue to change to meet the needs of the ever changing society. Feeding the world's population sustainably is a global challenge and research has an important role to play. There is a need to focus attention on researches that will pave ways for increasing agricultural productivity to counter the risks posed by these challenges for food production and food security (Ringler, 2011). Some of these challenges can be overcome when scientists from across disciplines collaborate. A robust research programme will be needed to meet the global challenges of food security. In Nigeria and even Africa as a whole, innovative approaches to production and storage of agricultural produce will be required to meet the challenges. Researches should address components of sustainable food security such as food production and better nutrition, integration of natural resources, forestry and fisheries, integrating new areas of science e.g. biotechnology, communication and information technology, intensifying application of Biochemical and molecular tools to develop improved crop varieties, adapting to urbanization.

Researches carried out by scientists at universities, colleges and research institutions have been instrumental to the achievements gained in food production while extension workers helped with the dissemination of knowledge generated to farmers and other stakeholders. Extension service has been instrumental to the development of farmers' knowledge about improved farming techniques and cultural practices as well as source of improved seed varieties and livestock and their roles in extending predicted climatic conditions such as early rainfall, late rainfall, etc.. This collaboration should be intensified.

Food insecurity due to insurgency – the case of '*Boko Haram*'

'*Boko* Haram' (BH) is an extremist group based in North-eastern Nigeria and also active in Chad, Niger and northern Cameroon. The activities of the group started in 2002 but became violent in 2009 following an uprising which led to the extrajudicial execution of its leader. Since then the attacks have metamorphosed into suicide bombings of government establishments, public places, massacre of people including students and mass abductions including the kidnapping of 276 Chibok girls in April 2014. They have claimed many lives about 17,000 since 2009 and displaced 2.3 million people (https://en.wikipedia.org/wiki/Boko_Haram).The insurgency has displaced most people in the rural areas, which are the main farming regions of Borono state as most of the rural settlers have fled their settlements to urban areas and even to other states. The states mainly affected in Nigeria are Borno, Yobe and Adamawa states. According to Joint Humanitarian Action Plan (JHAP), 9.1 million people are vulnerable and 5,972,672 persons were affected by food insecurity due to livelihood disruption from missed harvest seasons and increased food prices in 2015 (Tari et al., 2016). Agriculture including farming, fishing and animal husbandry is the main occupation in the North-east involving 80% of the population. According to an assessment by Famine Early Warning System Network (FEWS NET) in late 2014, vast areas in Yobe, Borno and northern Adamawa were under-cultivated and/or not harvested during May to December farming seasons as a result of attacks and conflict – related fears (https://reliefweb.int/report/Nigeria/Nigeria-food-security-alert-january-7-2015). Similarly, dry season farming and fishing activities were very low in 2015 due to the intensity of the conflict as evidenced by prevalent relative scarcity of seasonal crops and fish. Consequently, food is scarce amongst households and income from agriculture has become tremendously low. With attacks on livestock and conflict disrupting markets, income from livestock sale were also very low (https://reliefweb.int/report/Nigeria/Nigeria-food-security-alert-january-7-2015). The fact that agriculture, which is now seriously affected, is the main stay in the region with the majority of the people not educated and very little job opportunity in the non- agricultural sector poses a major risk. The anticipated result is insufficiency in food, malnutrition, and poverty due to loss of income from agricultural produce. Although the resilience of the insurgents has been weakened from 2015 with the coming of the new administration, still, only a small proportion of the IDPs have been resettled in their areas, majority are still in IDP camps and residences of family and friends. The fact that farming activities have not resumed in earnest in the besieged areas is evidence that food insufficiency is likely to remain for some time (Tari et al., 2016).

Since 2009, massive migration from rural areas was witnessed in parts of North-eastern region (Borno, Yobe and Adamawa states) of Nigeria where BH crisis is most affected. This migration were consequent to destruction of villages, massacre of people, destruction of farms, kidnappings and other atrocities perpetuated by the insurgents. These forced residents to flee from their homes to the cities. Camps were set up for IDPs, while a great many IDPs resettled with families and friends. This exodus, whether in quest for greener pasture or fleeing from insurgency like BH or similar crises, has a devastating effect on agricultural activities. This is because farming is disrupted as farmers have abandoned farming whether by choice or by force and this becomes a setback to achieving food security. Then there is the burden of feeding the displaced. Food security for IDPs requires urgent attention. Many groups and organizations including the National Emergency Management Agency (NEMA), and their State counterparts are working round the clock to provide food to the refugees. Similarly, several non-governmental organizations (NGOS), including foreign organizations, embassies of foreign countries have been contributing greatly to ensure that IDPs get regular food supplies but despite that, many cases of malnutrition are reported daily

in the IDP camps. This means that the food situation in the camps needs to be improved. Ensuring adequate and nutritious food for children and adults in the North-Eastern part of Nigeria has been a challenge and will continue to be a challenge considering the number of IDPs.

Innovative alternative farming techniques

Most farmers are used to the conventional farming techniques but considering the situation in the crises ridden regions, there is a need to try innovative approaches because of the benefits they hold. These benefits include; use of less energy from reduced transport and/or fertilizer use, increase in crop diversity and resiliency, local access to healthy fresh foods, ability to withstand potential shortages by diversifying the food supply, job creation and strengthening of underutilized or abandoned urban areas. The innovative alternative techniques that are highlighted in this paper are roof top gardening, hydroponics and straw bale gardening. Local food production can be increased through these alternative farming techniques.

Rooftop gardening

A roof garden is a garden on the roof of a building. The benefits include, decoration, provision of food, temperature control, hydrological benefits, architectural enhancement, habitats or corridors (Lundberg, 2009) for recreational opportunities, and in large scale it may even have ecological benefits. The practice of cultivating food on the rooftop of buildings is sometimes referred to as rooftop farming (http://en.m.wikipedia.org/wiki/Roof_garden). Rooftop farming is usually done using green roof, hydroponics, aeroponics or air-dynaponics systems or container gardens (Nowak, 2004).

The practice of growing plants on roofs by humans is not new. The Ziggurats of ancient Mesopotamia (4th millennium BC–600 BC) planted trees and shrubs on above ground terraces (https://en.wikipedia.org/roof-garden). An example in Roman times was the Villa of the Mysteries in Pompeii, which had an elevated terrace where plants were grown (Osmundson, 1999). A roof garden has also been discovered around an audience hall in Roman-Byzantine Caesarea (Littlewood et al., 2002). The medieval Egyptian city of Fustat had a number of high-rise buildings that Nasir Khusraw in the early 11th century described as rising up to 14 stories, with roof gardens on the top story complete with ox-drawn water wheels for irrigating them (Doris, 1992).

Among the Seven Wonders of the Ancient World, The Hanging Gardens are often depicted as tall structures holding vegetation with even immense trees. Roof gardens are mostly found in urban areas. The ecological impact of roof gardens includes the ability to reduce the overall heat absorption of the building which then reduces energy consumption. The primary cause of heat build-up in cities is insolation, the absorption of solar radiation by roads and buildings in the city and the storage of this heat in the building material and its subsequent re-radiation. Plant surfaces however, as a result of transpiration, do not rise more than 4–5 °C above the ambient and are sometimes cooler (Ong, 2003). According to a study conducted by Brahic (2007), this leads to a cooling of the environment between 3.6 and 11.3 degrees Celsius (6.5 and 20.3 °F), depending on the area on earth (in hotter areas, the environmental temperature will cool more). This indicates that roof gardens are beneficial in reducing the effects of temperature against roofs. If widely adopted, especially in the North-eastern part of Nigeria where environmental temperatures are relatively higher, rooftop gardens could reduce the urban heat, problems associated with heat stress and further lower energy consumption.

In an accessible rooftop garden, space becomes available for localized small-scale urban agriculture, a source of local food production. An urban garden can supplement the diets of the community it feeds with fresh produce and serve as a means of food production. At Trent University, there is currently a working rooftop garden which provides food to the student café and local citizens (http://en.m.wikipedia.org/wiki/Roof_garden).

For those who live in small apartments with little space, square foot gardening, or (when even less space is available) green walls (vertical gardening) can be a solution, especially through genetic modification of some crawling food crops. These use much less space than traditional gardening (square foot gardening uses 20% of the space of conventional rows; ten times more produce can be generated from vertical gardens). These also encourage environmentally responsible practices, eliminating tillage, reducing or eliminating pesticides, and weeding, and encouraging the recycling of wastes through composting.

Hydroponics

Hydroponics is defined as a method of growing plants using mineral nutrient solutions, in water, without soil. Terrestrial plants may be grown with their roots in the mineral nutrient solution only, or in an inert medium, such as perlite or gravel. The earliest published work on growing terrestrial plants without soil was the 1627 book on *Sylva sylvarum* by Francis Bacon (https://en.wikipedia.org/wiki/hydroponics). Water culture became a popular research technique after that. In 1929, William Frederick Gericke of the University of California began publicly promoting that solution culture be used for agricultural crop production (https://en.wikipedia.org/wiki/hydroponics). The advantage of hydroponics is that, the technique makes it possible to grow even plants that are not traditionally grown in a climate. Hydroponics also saves water; it uses as little as 1/20 the amount for a regular farm to produce the same amount of food. Hydroponics has been used to enhance vegetable production to produce more nutritionally valued crops. A hydroponic farmer in Virginia has developed a calcium and potassium enriched head of

lettuce (Lakkireddy et al., 2012). NASA has considered the possibility of utilizing hydroponics in the space program. Ray Wheeler, a plant physiologist at Kennedy Space Center's Space Life Science Lab, believes that hydroponics will create advances within space travel.

There are two main types of hydroponics; solution culture and medium culture. Solution culture does not use a solid medium for the roots, just the nutrient solution. The medium culture method has a solid medium for the roots and is named after the type of medium, e.g., sand culture, gravel culture, or rockwool culture (https://en.wikipedia.org/wiki/hydroponics).

Plant nutrients used in hydroponics are dissolved in water and are mostly in inorganic and ionic form. The hydroponic solutions comprise of different combinations of chemicals to reach similar total final compositions. The most commonly used chemicals for the macronutrients include potassium nitrate, calcium nitrate, potassium phosphate, and magnesium sulfate. Some micronutrients are also added to hydroponic solutions to supply essential elements; these include Fe (iron), Mn (manganese), Cu (copper), Zn (zinc), B (boron), Cl (chlorine), and Ni (nickel). Chelating agents are sometimes used to keep Fe soluble, and humic acids can be added to increase nutrient uptake (Adani et al., 1998).

Straw bale gardening

A straw or hay bale garden is a gardening method used for raising vegetables, herbs and flowers directly on a bale. Straw or hay from wheat and other cereals are suitable for making a garden bed. Straw is an ideal "container" for growing vegetables. The hollow tubes are able to suck up and hold moisture. And as the insides of the bales decompose, they provide a rich medium for vegetable growth. A straw bale garden can be prepared anywhere that gets at least six to eight hours of sunlight. this type of garden especially good for growers who live in northern climes with shorter growing seasons — the bales heat up much quicker than soil, stimulating early-season root growth (Desta and Ophardt, 2013).

CONCLUSION

Nigeria is one of the developing countries facing food security challenges despite the Sustainable Development Goals of achieving food security by 2030. This is at a time when the Country is facing economic recession, becoming more populated and is ravaged by hunger, mal-nutrition, poverty, militancy, clashes between herdsmen and farmers and the lingering BH insurgency. In addition, the problems of soil infertility, floods, aridity, climate change etc. still prevail. The Boko-Haram insurgency has forced many farmers in the North-eastern region, which is a major farming zone with substantial produce coming from there, to flee their homes and abandon their farms. Consequently, food production has been substantially reduced, making the hope of achieving food security appear like a dream.

The internally displaced persons resulting from BH insurgency are in IDP camps posing a burden to government, NGOs and well spirited individuals who support the camps with food supplies. Moreover, while the government including foreign governments, non-governmental organizations and other aid groups intervene in these camps, food still remains inadequate. There is therefore an urgent need to devise other means of food production for the IDPs. Inputs from Science and Technology on innovative approaches to increasing food production, storage and manufacture etc. are required. New farming methods from traditional practices and international examples could open the key to achieving sustainable food security and access to safe and better nutrition in Nigeria and Africa as a whole. For the traditional practices, there are many techniques practiced by farmers which are beneficial but scientists are yet to study them adequately for the purpose of investigating the principles behind them or improving them. With respect to international examples, some may have certain values that may benefit the farmers and can therefore be adopted or modified to suit the local environment. Some international examples includes, roof top gardening, hydroponics, straw bale gardening and other innovative farming techniques which is capable of increasing food availability in camps as well as means of livelihood to the IDPs. With proper research, field trials and extension services, the techniques can even serve to increase food production without increasing the land use towards achieving food security by 2030.

Conflict of interests

The authors declare that they have no conflicting interests

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