

Strategies, tools and options in biodiversity to ensure sustainable dairy development in India in a global context

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Abstract

Ensuring biodiversity is a global concern and is part of the long-term agenda of many national, global institutions. Many countries have understood many years back that sustainability is very important to ensure that the potential of any sector can be explored. Accordingly, they have enforced in policies by analyzing various options and strategies in a timebound manner to ensure sustainable dairy development. India has many challenges to overcome to ensure that economic development is continued in a progressive and sustainable manner. A review of the tools and strategies and progress achieved by many countries will enable India to look forward to making a robust and sustainable plan for dairy development. Recently, the political process in India has begun to recognize the registration of indigenous breeds of livestock. There is also a challenge of managing unproductive cows versus balancing religious beliefs and economic goals. Another important concern is of environmental sustainability in the context of the role of GHG emissions by dairy animals. There is a significant potential to harness IT technologies to plan sustainable projects. The other important area is the leadership and execution. Monitoring the progress in achieving biodiversity, needs a suitable framework to conceptualize, understand, develop and review through a set of indicators. Lot of initiatives in this direction are in progress and could be useful to review for developing a national biodiversity policy for dairy development. What policy measures of the government like taxation and subsidies, pricing, duties and tariffs, markets and priorities will help to lead to biodiversity and balanced micro and macroeconomic dairy development? To answer these questions, the paper investigates some of the challenges that the Indian dairy sector is facing and what tools, options and strategies are possible to develop a long term sustainable dairy sector in India in a free and open global environment.

Keywords: *biodiversity, Indian dairy, environment, management, sustainability, breeds, policies*

STRATEGIES, TOOLS AND OPTIONS IN BIODIVERSITY TO ENSURE SUSTAINABLE DAIRY**DEVELOPMENT IN INDIA IN A GLOBAL CONTEXT****INTRODUCTION**

Indian dairy sector is playing a major role as a source of livelihood for millions of farmers and the supply chain and will continue to do so in the years to come. (Sharma, Kumar, Pal, & Wadhawan, 2015) The role of biodiversity in ensuring sustainable development has been acknowledged by the 2030 millennium agenda of the UN Sustainable Development. Biodiversity conservation is the practice of protecting and preserving the abundance and variety (biodiversity) of all species, regardless of classification, ecosystems, or genetic diversity on the planet. Land use for dairy production, including for off-farm feed production can have an impact on natural landscapes and habitats. Dairy has a role to play, alongside other land users, in contributing to the protection of high value conservation areas. Though many countries have in place, a mechanism to ensure, monitor and develop the ecosystem, India is gearing up to meet the challenges, but needs to do much more to ensure that the goals of sustainable bio-ecosystem by 2030 is achieved. The paper looks into the challenges, the options, tools and policies necessary to ensure the same.

CHALLENGES FACED BY INDIAN DAIRY SECTOR

Improving productivity, reducing costs of operations and ensuring greater availability of milk and milk products has been a long-time challenges and the need to accelerate the use of modern technologies to ensure the same has increased in present modern times (Mathur, 2000).

The demand for milk and milk products is rapidly increasing with achievement of high economic growth in India. While in the past, India was able to meet its milk demands through

dairy development programmes like Operation Flood focusing on the marketing operations and infrastructure, present demand calls for augmenting productivity as the sustainable approaches. However, the present level of technological innovations is proving to be of limited use in solving these issues like animal genetic improvement, feed availability, veterinary and support services, lack of research and development support and market access to smallholders, market failures, climate change, etc. (Gautam, Dalal, & Pathak, 2010). A need has been felt for a long time to have a multifaceted programme to overcome these complex challenges in the dairy sector.

Infrastructure needs to be strengthened for the improvement of milch breeds of cattle and buffaloes in context with the 14 agro-climatic zones of the country. Apart from this due to increasing consumer awareness there has been an increased concern voiced over quality of milk and milk products including contamination, pollutant and the residual effect of various chemicals which is indirectly affecting natural processes, biodiversity and soil life. The government has already initiated a number of policies and programs that are tuned in overcoming these challenges, but a lot needs still to be done.

IMPORTANCE OF BIODIVERSITY

Agricultural biodiversity is a broad term that includes all components of biological diversity of relevance to food and agriculture, and all components of biological diversity that constitute the agricultural ecosystems, also named agro-ecosystems: the variety and variability of animals, plants and micro-organisms, at the genetic, species and ecosystem levels, which are necessary to sustain key functions of the agro-ecosystem, its structure and processes (COBD, 2017). Many world organizations like UN have time and again reinforced the importance of biodiversity in ensuring sustainable development. The UN has come up with a convention on

Biological Diversity in 2015 for its implementation with the primarily goal of full implementation of the 2030 Agenda for Sustainable Development (UN, 2015).

Role of biodiversity in ensuring sustainable Indian dairy sector

Dairy farming has the potential for providing additional income to the farmers along with achieving major goal of organic farming i.e. diversified production and supporting biological cycle within farming system. (Maji, Meena, Paul, & Rudroju, 2017)

a. Quality milk production

In order to solve the concern over quality of milk and milk products, generic advantages in India like traditional nature of farming and indigenous technical knowledge and practices followed by Indian farmers.

b. Organic milk production

Dairy farming has the potential for providing additional income to the farmers along with achieving major goal of organic farming i.e. diversified production and supporting biological cycle within farming system. (Maji, Meena, Paul, & Rudroju, 2017)

c. Adulterant free milk production

Excessive use of agri-chemicals, antibiotics is not only harmful to the conservation of animal, plant and soil flora and fauna but also puts into risk human health and its progeny.

d. Sustaining livelihoods

Ensuring biodiversity will help to ensure the base for farmers' sustenance. Farmer is dependent on the flora, fauna and the natural resources to ensure sustainability. This is one area where farmers is dependent on the community to ensure that his base is safe. Ensuring the sustenance and preservation of genetic diversity, the land resources, the micro-fauna and flora, the water availability and overall the climate has become a very big and complex area to ensure that

farmers are able to continue to make their livelihoods and thereby sustain the rising food demands in the future.

e. Profiting through agro-biodiversity

Taking suitable measures to ensure biodiversity by proper management practices like prevention of soil compaction, less grassland renewal, sowing grass/clover, mowing grass mixtures, increasing cow lifetime, growing substitutes for concentrate feeds, fertilizer application and efficient irrigation can help to ensure farm profitability if combined with cooperation between farmer groups like crop and dairy. Proper measures on the biodiversity impact helps to make operational choices, scale up and disseminate the practices. ZLTO (2012) have shown exactly this through the Farmers and Agrodiversity project in Netherlands.

REVIEW ON THE PROGRESS IN BIODIVERSITY TOOLS, STRATEGIES AND POLICIES

Improving productivity, reducing costs of operations and ensuring greater availability of milk and milk products has been long-time challenges and the need to accelerate the use of modern technologies to ensure the same has increased in present modern times (Mathur, 2000). Infrastructure needs to be strengthened for the improvement of milch breeds of cattle and buffaloes in context with the 14 agro-climatic zones of the country. Apart from this due to increasing consumer awareness there has been an increased concern voiced over quality of milk and milk products including contamination, pollutant and the residual effect of various chemicals.

a. Biodiversity informatics

Biodiversity informatics is the application of information techniques for improved management, presentation and analysis of biodiversity information (Morrison , 2012). This will play a very important role in making major advances in biology where integration and synthesis is more important than decomposition and reduction. Though lot of efforts have gone into trying to change the way things will be done in future, but a lot is much more to be done to solve the current problems which have already been identified since a long time. A first step in this process is to create and manage a database consisting of the variety of species over time , genetic diversity within species over time, land use change, and observance of high value conservation areas. (www.saipatform.org).

b. GIS-based management tool for biodiversity conservation

Regions vulnerable to biodiversity erosion need suitable management tools to manage and conserve biodiversity in these regions. An implementation process of the same using GIS has been tried in the Capital of Norway , Oslo through proper inventory of biological resources and possible combination with other information for decision making. (Pedersen, Nyhuus, Blindheim, & Krog, 2004). Monitoring biological diversity indicators like species richness can be done using remotely sensed data, however more efforts to integrate it with ongoing Earth System and global change programs will enable remote sensing to be used as a prominent data acquisition and analysis tool. (Stoms & Estes, 1993)

c. Biodiversity monitoring using novel data collection technologies

Development of state of the art miniature radio transmitters, tagging technologies using geo-location, bioacoustics, smartphones and social networking, genetic technologies and genomic observatories, access to global data sets such as GBIF, Catalogue of life to make biological and

environmental links, and to help biodiversity scientists to forge new cross-disciplinary collaborations and to think bigger and more ambitiously. (Snaddon, Petrokofsky, Jepson, & Willis, 2012)

d. Process development for assessing offsetability of biodiversity impacts

Biodiversity offsetting is increasingly being used to reconcile the objectives of conservation and development. (Pilgrim, et al., 2013). This involves policy guidance as to what defines the limits to impacts on biodiversity that can or should be offset. Rankings for biodiversity conservation concern are drawn from existing conservation planning tools and approaches, including the IUCN Red List, Key Biodiversity Areas, and international bank environmental safeguard policies.

e. Knowledge sharing tools

The dissemination of knowledge about (agro)biodiversity is a strategic factor in communicating the urgent need to defend and protect biological diversity. Various social media tools are being used to propagate the importance, role and options to conserve biodiversity. This is especially important due to their collaborative nature, free of charge, multilingual and accessible online, and updation possibility. Wikipedia is a very live example where it is used as a dissemination tool on propagating information and references on various biodiversity issues and solutions (Signore, Serio, & Santamaria, 2014).

f. Biodiversity Index for facilities management

It is very important to measure biodiversity to take and manage efforts to conserve the eroding natural resources. Development in this area have covered critical areas such as the loss of our heritage, legislative, economic and social drivers, the Biodiversity Index tool and the reasons why organizations should assess and manage their biodiversity. (Ollerton, 2013) This

Biodiversity Index tool is designed to help a range of organizations manage the biodiversity on the land around their site. The tool comprises a practical method to assess plant diversity at an urban location; information on why biodiversity is important; how to report it; and how to manage it.

g. Grazing as a tool for biodiversity of grassland

animal grazing can be a tool to maintain or restore biodiversity of open landscape and contribute to the aesthetic and leisure importance of grassland. The successful use of grazing for environment protection and biodiversity enhancement requires careful planning and should be adapted to local conditions. (Metera, Sakowski, Słoniewski, & Romanowicz, 2010).

Dairy farming for biodiversity conservation

h. Estimating impact of global warming on biodiversity

Habitat loss and fragmentation by upward migration of bioclimatic conditions is analyzed using Species-Area Relationships (SAR) and Altitudinal Range Displacement (ARD) analysis. The ARD is a tool that uses the present-day lapse rate to estimate the upward migration of the species based on the global warming predicted by the IPCC. The results show that around 80% of the vascular flora, ca. 1,700 species of which up to 400 would be Pantepui endemics, are threatened of extinction. These estimates should be considered preliminary, but the danger is real.

Therefore, suitable conservation or mitigation strategies are needed. (Nogué, Rull, & Vegas-Vilarrúbia, 2009)

i. Development of Animal and Plant Biodiversity Atlas

Establishment of global inventories of biospecies and the study of diversity and endemism patterns of rare and endangered species is the first step in conserving biodiversity and planning.

This will enable to identify biodiversity hotspots and map spatial biodiversity distribution.

(Kohlmann, 2011)

j. Environmental DNA for biodiversity monitoring

To halt or slow down the continuous decline in Earth's biodiversity, new alternative and efficient techniques are needed for large scale biodiversity monitoring. eDNA-based approaches are tending to move from single-marker analyses of species or communities to meta-genomic surveys of entire ecosystems to predict spatial and temporal biodiversity patterns. Such advances have applications for a range of biological, geological and environmental sciences. (Thomsen & Willerslev, 2015)

k. Exploring under and overutilized dairy breeds and species

Widening the biodiversity knowledge base is an important step to the conservation and sustainable use of agriculture and farm products such as milk, meat, eggs, grains and vegetables, etc. This will help to make better decisions for utilizing the potential use of biodiverse useful species for solving food and nutrition security as well as conserve these resources. (Medhammar, et al., 2012)

l. Developing and monitoring suitable indicators for biodiversity in dairying

The region based and environmental and socio-economic characterization of regions defines the need for specific measures to monitor and control for biodiversity conservation. As an example, the Netherlands has come up with goals for preservation of grazing (81.2% levels as in 2012), share of responsibly purchased soy feed (100%), phosphorous production levels below the European limit (173 million kg), target reduction in ammonia emissions from dairying, no net reduction of biodiversity through a latest monitoring system to be developed by 2017

INITIATIVES TAKEN BY INDIAN STAKEHOLDERS AND RESULTS

Improving productivity, reducing costs of operations and ensuring greater availability of milk and milk products has been a long-time challenges and the need to accelerate the use of modern technologies to ensure the same has increased in present modern times (Mathur, 2000). Infrastructure needs to be strengthened for the improvement of milch breeds of cattle and buffaloes in context with the 14 agro-climatic zones of the country. Apart from this due to increasing consumer awareness there has been an increased concern voiced over quality of milk and milk products including contamination, pollutant and the residual effect of various chemicals.

a. Formation of Acts / policies and National Biodiversity Authority and its state units

Over the years, Indian Government has enacted many acts and policies to ensure biodiversity of the country is preserved and improved upon. With reference to dairy sector, the following acts have special significance:

1. The Indian Forest Act, 1927.
2. Prevention of Cruelty to Animals Act, 1960.
3. Seeds Act, 1966.
4. Water (Prevention and Control of Pollution) Act, 1974.
5. Water (Prevention and Control of Pollution) Cess Act, 1977.
6. Forest (Conservation) Act, 1980.
7. Air (Prevention and Control of Pollution) Act, 1981.
8. Environment (Protection) Act, 1986
9. National Forest Policy, 1988

10. Rules for the manufacture, use / import / export and storage of hazardous
11. microorganisms / genetically engineered organisms or cells, 1989
12. National Conservation Strategy and Policy Statement on Environment and
13. Development, 1992
14. National Policy and Macro level Action Strategy on Biodiversity,
15. 1999 amended to NBSAP
16. National Agriculture Policy, 2000
17. Protection of Plant Varieties and Farmers' Rights (PPVFR) Act, 2001
18. Biological Diversity Act, 2002
19. Biological Diversity Rules, 2004
20. Scheduled Tribes and Other Traditional Forest Dwellers
21. (Recognition of Forest Rights) Act, 2006.
22. National Environment Policy, 2006
23. Wetland (Conservation and Management) Rules 2010
24. National Water Policy, 2012
25. National Biodiversity Authority formed in 2002 is entrusted

b. Conservation of locally domesticated dairy breeds and endangered species like wild buffaloes

In order to solve the concern over quality of milk and milk products, generic advantages in India like traditional nature of farming and indigenous technical knowledge and practices followed by Indian farmers. The Centrally Sponsored Scheme 'Integrated Development of Wildlife Habitats' has been modified by including a new component namely 'Recovery of Endangered Species' in which wild buffalo is included.

c. Supporting livelihoods through proper management training and access to unconventional dairy animals like goat, yak in ecologically fragile zones

Dairy farming has the potential for providing additional income to the farmers along with achieving major goal of organic farming i.e. diversified production and supporting biological cycle within farming system. (Maji, Meena, Paul, & Rudroju, 2017). In many regions, Goat, Yak development is supported with proper breeding, markets and policies, leading to increase in livelihood options and also ecological conservation.

d. India Business & Biodiversity Initiative (IBBI)

IBBI was launched on 22 May 2014 on invitation by Ministry of Environment, Forests and Climate Change (MoEFCC). It Serves as a national platform for business and its stakeholders for dialogue, sharing and learning, ultimately leading to mainstreaming sustainable management of biological diversity into business decisions, policies and operations

e. Rashtriya Gokul Mission

The Rashtriya Gokul Mission is a programme launched by the Central Government in 2014 and implemented by the state government with the objective of promoting and conserving indigenous dairy breeds in a focused and scientific manner. Unique characteristics linked to disease resistance, heat tolerance, withstand extreme climatic conditions and A2 allele of Beta Casein milk, which makes its better than A1 milk associated with exotic cattle milk and reportedly associated with metabolic disorders like diabetes ,heart diseases etc.

RECOMMENDATIONS AND SUGGESTIONS FOR FUTURE ACTION PLAN

Infrastructure needs to be strengthened for the improvement of milch breeds of cattle and buffaloes in context with the 14 agro-climatic zones of the country. Apart from this due to

increasing consumer awareness there has been an increased concern voiced over quality of milk and milk products including contamination, pollutant and the residual effect of various chemicals. (Mathur, 2000). Biodiversity concerns and challenges in dairy development in India can be overcome through a series of integrated and holistic efforts by all stakeholders. Specific initiative activities / projects / policies can be grouped under:

a. Awareness building programs and projects

Groot and Hooft (2016) in a paper comparing the use of Antibiotics in Netherlands, India, Ethiopia and Uganda have suggested raising consciousness about the risk of antibiotics and their effect on food quality and implementing the 5-layer approach for reducing the use of antibiotics and other chemicals. This approach is based on improving animal and farm management, revitalizing ethno veterinary knowledge and the use of medicinal plants, genetic improvement through strategic use of local breeds, establishing quality control systems in the dairy chain, and extra payment to farmers for residue-free milk.

b. Innovative financial products

Rabobank has come up with innovative financial products like Green Loan or Impact Loan. Herein, Rabobank provides reduced interest rate loans to businesses which can demonstrate a high sustainability performance including the agro-ecosystem. Public sector banks like European Investment Bank provides the capital in order to finance solutions to major challenges as defined in the Sustainable Development Goals for emerging and Pioneering markets (Rabobank, 2018).

c. Innovative monitoring systems

Rabobank in cooperation with World Wide Fund for Nature Netherlands (WWF) have teamed up with dairy companies like Friesland Campina to develop the Biodiversity Monitor (Rabobank, 2018). This provides useful insights to the farmer to reduce their operating costs

through sustainable management, better lease conditions, interest rate options, or through a bonus / penalty pricing system for milk. A supply chain approach will encourage other partners and stakeholders to use the monitor as a guiding tool to benchmark, monitor and act upon to ensure sustainable development and biodiversity conservation. The use of information technologies and data dissemination and accessibility in real time has made it possible for the stakeholders from farm to fork to take necessary steps to map and benchmark their biodiversity level, create a plan and make followup actions. These initiatives can be monitored and necessary decision can be taken regularly to monitor the progress and development over a period of time. Dairy Australia has been doing this through their online platform in mapping the resources, and also building the skills and capacity of its farmers to manage biodiversity.

(biodiversity.dairyaustralia.com)

d. Policies for maintaining genetic variability in dairy cows

Selective breeding policies throws significant risks in reducing genetic variability availability in the future. Proper mechanism in check like rational payment systems, use of crossbreeding where profitable, inclusion of all economically important traits in the breeding objective, recognition of genotype by environment interactions and the use of selected algorithms that balance estimated breeding value against the average relationship among the selected animals (Brotherstone and Goddard, 2005).

e. Biodiversity score-based milk payment system

Innovative methods to assess the biodiversity potential at farm and product levels (Schader et al. 2014) wherein prevalence of Indicator Species Groups (ISGs) linked to farming practices based on food-web relationships between the ISGs could be useful to insure biodiversity compliant practices. Milk from organic farms received 4–79% higher biodiversity scores than milk from conventional farms in all regions.

f. Promoting practices to restore biodiversity in feed and fodder cropping systems

Inclusion of non-crop vegetation on farmland, restoration or constructed wetlands could contribute to resilience of agricultural systems through reduced soil erosion, increasing soil microfauna or control pests naturally or remove water quality contaminants. (Styslinger 2018).

g. Developing biodiversity action plan for the stakeholders in supply chain from farm to fork

The use of information technologies and data dissemination and accessibility in real time has made it possible for the stakeholders from farm to fork to take necessary steps to map and benchmark their biodiversity level, create a plan and make followup actions. These initiatives can be monitored and necessary decision can be taken regularly to monitor the progress and development over a period of time. Dairy Australia has been doing this through their online platform in mapping the resources, and also building the skills and capacity of its farmers to manage biodiversity. (biodiversity.dairyaustralia.com)

h. Promotion of sustainable food supply practices with private stakeholders

The government and the private have come together in promoting sustainable development through biodiversity conservation. In UK, under the Green Food Project, TESCO have formed a sustainability group of 700 farmers to ensure fair pricing of milk to farmers under the condition that they respect quality and welfare standards.(EC, 2012)

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