Case study description: Small-holder dairy farming in Gujarat, India

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Background

Keeping livestock is a major livelihood for many farmers in India and about 70% of rural communities depends on livestock as a critical source of income. The dairy production in India is mainly based on small holder farmers. Eighty-six percent of Indian farmers are classified as small-scale, marginal farmers with having herd sizes of 1 to 5 animals. Small scale milk producers contribute 62% of the total milk produced in the country [5].

India's dairy industry is said to face multiple challenges, for example the high demand for milk production despite land and pasture, as well as feed shortage and unreliable water resources. Furthermore, the indiscriminate use of antibiotics and other animal drugs has led to high drug residues in animal products, like milk, as well as polluting the environment. For this reason, the National Dairy Development Board (NDDB) has supported the promotion of ethno-veterinary practices (EVP) in India, such as the use of health promoting herbs as feed and for primary veterinary health care. This is well accepted by many dairy farmers.

We use this management practice in Indian's small-holder dairy production system as one of the case studies in Wageningen Knowledge Based Food and Water Security programe - project Nature Positive Food Systems (project code KB-35-101-003). This document provides background information and local details to inform our field visit and stakeholder analysis.

Aim of the case study and the field visit

This case study aims to provide an improved understanding of the Indian system and to translate the knowledge of stakeholders to herbal pastures on Dutch dairy farms as a nature positive food system, also improving animal health, food safety and biodiversity. The scheduled field trip to Anand in February 2024, aimed to identify enablers, barriers, effects on nature of small-holding dairy farming as a food system, and individual feed and water usage, by using and testing a stakeholder analysis methodology CANVAS (see appendix 1).

Anand is known as the Milk Capital of India. Amongst others this city hosts the Head Office of Gujarat Cooperative Milk Marketing Federation Ltd (AMUL) and the NDDB of India.

The environment in India

Bharath (as India is referred to by locals) is one of the oldest civilizations in the world and seventh largest country, with an area of 3287263 sq km. India's diverse geography and climactic conditions have resulted in a variety of ecosystems. India has four of the 34 globally recognized biodiversity hotspots and hosts six major climatic subtypes, ranging from arid desert in the west, alpine tundra and glaciers in the north, and humid tropical regions supporting rainforests in the southwest and the island territories. Many regions have starkly different microclimates. The Meteorological Department define the four seasons as: winter (mid-December to mid-March), summer (mid-March to May), rainy (June to September), and retreating monsoon (October to mid-December).

The state of Gujarat (figure 1) is very hot and humid in summer and cold and dry in winter. Summer is milder in the hilly regions and the coast. The average daytime temperature during winter is around 29 °C and at night it is around 12 °C with mainly sunny days and clear nights.

Figure 1. The state of Gujarat (marked in yellow).

India is suffering great environmental challenges due to population explosion, uncontrolled growth of urbanization and industrialization and intensification of agriculture [1]. This leads to food production and population pressure on land and can potentially lead to a loss of biodiversity and decreased sustainability.

There are currently several nature conservation programs in India (with a focus on wildlife and biodiversity conservation), but only 5% of the land is protected [2]. Literature reveals that conservation and agrobiodiversity is currently receiving a lot of attention in India. A survey recently published by an Indian newspaper shows that nine out of 10 Indian respondents were willing to protect and restore nature. Meanwhile, 70% of Indians are worried about the present state of nature, but are unsure how they can help tackle the issues of climate change (gaonconnection.com).

Food system description (dairy focus)

India is the world's largest producer of milk, accounting for 23% of the global share [3, 4]. The dairy sector contributes 5% to the overall national economy. Seventy five percent of rural households in India has dairy animals and this plays a significant role in the socioeconomic development. India has about 75 million dairy farms, with 86% small-scale farmers, contributing 62% of the total milk production [5]. However, small-scale farmers own only about 33% of land [6].
Dairying has been a traditional family activity in India, with particularly women playing a key role. Nearly 70% of the work in dairying is contributed by women (figure 2).

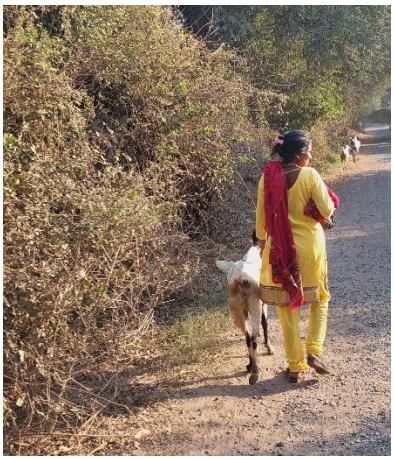

Figure 2. A lady farmer with her goat.

In Indian indigenous buffaloes contributes to 31.58% of milk production and crossbred cows 29% (2022). Medium-sized dairy producers typically own 10 to 50 cows. These enterprises are growing.

In 2023, India also consumed the most cow milk worldwide, drinking over 87 million metric tons [7]. The next largest consumption of milk was in the European Union, at 23.7 million metric tons. India exports a small portion of its dairy milk products to the United Arab Emirates, the United States and Bangladesh.

The introduction of crossbreeding with exotic breeds in India was mainly aimed at enhancing milk production. However, the high incidence of diseases in these cross-bred animals, potentially exacerbated by insufficient management and feeding systems, lead to the indiscriminate use of antibiotics and other animal drugs and subsequently high antibiotic residues in animal products, like milk. The large majority of farmers and the public are however not aware of drug residues in food products from animal origin, or about the development risks of antimicrobial resistance [8]

Feeding systems

Land degradation is increasingly becoming a major concern for Indian agriculture [9]. A large number of dairy farmers do not own land. They have to purchase whatever feed is needed for their animals. Farmers who do own land generally cultivate grass and have a variety of crops suitable for that region. Weakening traditional institutions and increasing land pressure have threatened the natural grazing lands. Because of several reasons pastoralists are increasingly abandoning livestock production.

Climate variations like increasing temperature and decreasing rainfall are reducing the yield of pastures leading to overgrazing and degradation. In addition, climate change appears to be making arid and semi-arid areas even drier and extreme weather events like drought and floods, more common. Changing land use patterns, especially that of common and traditional pasture lands, is diverting a significant amount of the grazing pressure to forests. The National Forestry Action Programme (NFAP, 2023) estimates that around 60% of the livestock (about 270 million) graze in forests while the carrying capacity is only 30 million.

One of the major challenges of the livestock sector in India is shortage of feed and fodder. Feed constitutes concentrates (wheat bran, oilcakes etc), dry fodder and green fodder. Farmers are increasingly moving away from cereal production, to crops that yield less, but give a higher income, resulting in higher fodder prices. At present the shortage of feed and fodder in India is estimated at 12 to 15% for green fodder, 25 to 26% for dry fodder and 36% for concentrated fodder [10].

Different types of dietary feed ingredients are used for dairy cows and buffaloes. Some of the most common feeds include pasture grasses, cereal grains, hay and silage crops, and other by-products of food crops, such as brewers' grains, pineapple bran and sugar beet pulp. Traditionally concentrate is fed at the time of milking. Roughages are offered either before or after milking. Nutritionists advising on balancing rations of locally available feed resources are costly, and livestock owners use them only when they are sure of economic returns.

There is a tendency for selective feeding of livestock in India. Dry cows and old cows for example are typically not given any fodder. Goat and sheep herds usually live almost exclusively on what they can forage on common lands, in the forest or wastelands. Such farming practices could lead to overgrazing and erosion.

Water usage on Indian dairy farms

Milk production demands a significant volume of water, not just to fulfill the immediate needs of the animals (such as drinking and cleaning), but also to satisfy the indirect requirements, including the cultivation of forage crops and the production of concentrate feed ingredients.

A substantial portion of India's highly productive crop and milk output, particularly in the northwest, relies heavily on groundwater, a practice that has become unsustainable in numerous areas [11]. Livestock, particularly in arid and semiarid regions, are mostly reared under extensive or traditional pastoral farming systems and face the problem of water scarcity throughout the year.

During summer the water becomes a precious commodity in India. India's dependence on an increasingly erratic monsoon for its water requirements increases this challenge. Climate change is likely to exacerbate this pressure on water resources, even as the frequency and intensity of floods and droughts in the country increases. Water availability and quality are a major challenge for livestock and crop production systems.

Water sources in India are not always held and controlled as public property. Streams, rivers, village ponds and tanks are all in the public domain and all livestock of an area have access to them. But groundwater is accessed only through dug wells and tube wells, and these are in the private domain. The problem of access to adequate water is manifest mainly in regions which do not have a reliable all-year around public water source. In these areas, less affluent livestock owners must depend on either water made available to them by those who have their own wells or tube wells, or by an arrangement made with public agencies. Regions with perennial water scarcity at times also come up with social institutions that

facilitate collective survival. In several districts those with control of their own water source provide water for human and livestock consumption needs. However, this is neither universal, nor always sufficient. Livestock farmers are therefore often at the mercy of those who can provide water.

Use of health-promoting herbs

One of the priorities in the livestock sector in India over the last 15 years has been to find safe and cost-effective medicinal plant formulations to replace antibiotics, to help improve the health status of dairy herds and the environment and improve food safety. It is anticipated that ethno-veterinary herbal preparations have the potential to be a low cost and effective alternative to antibiotics for bovine disease management, not only in developing countries like India, but also in western countries.

Traditionally local herbs/medicinal plant formulations have been used for centuries in India to treat disease conditions, with good results. Herbs-rich diets and herbal remedies could lead to improved milk production and quality, healthier animals, less residues of antibiotics (and other drugs) in the milk and in the environment, and have the potential to aid in animal welfare, by helping animals dealing with, for example, heat stress. In modern times traditional knowledge has often been undervalued, or forgotten, perhaps also driven by the intensification of agriculture, to increase food production.

In India the Center for Ethno-Veterinary Science and Practice, of the University of Trans-Disciplinary Health Sciences and Technology (TDU) in Bengaluru record, assess, validate and promote the use of ethnoveterinary practices in India (and other countries) as a team under the leadership of Dr. MNB Nair. India has made great progress in understanding and promoting the use of herbs on dairy farms, particular under small holder dairy farmers. TDU, along with the NDDB, empowers these farmers to use herbal alternatives to prevent and cure disease conditions in cattle, which saves their expenditure on livestock health management and should lead to less residues in milk and milk products and in the environment [8]. The TDU promotes that, when herbs and herbal extracts are widely used, it can initiate a system change that leads to:

- Healthier, more resilient animals
- Improved milk production and quality
- Decreased chemical drug residues in the milk and the environment (waterbodies, soil, crops)

When the use of herbs are upscaled to herbal grasslands it has the potential to: [12]

- Improve soil structure and health

- Provides resilience in dry periods
- fixes nitrogen from legume species (a.o. requires little fertilizer)
- Extends the grazing season
- Benefits carbon sequestration
- Improves biodiversity of bird and insect species

Many small-holder farmers, farmers practicing organic farming and farms with a variety of crops, use locally grown herbs from their own herbal gardens (figure 3), or community gardens, to treat and prevent diseases. Most villages also have herbalist shops. Common herbs used are turmeric, cumin, coriander, asafoetida, fenugreek, black pepper, ginger, and tamarind. Farmers also use table salt, jaggery, butter, ghee, and oils from the kitchen. If any of the ingredients in a recipe are not available, they are substituted by a locally available herb of similar qualities.

Specifically, medicinal plants are included in remedies formulation. These are from a limited number of herb species. More than half of them are spices, which are generally cultivated, also for human consumption (e.g. ginger, turmeric, cumin, and coriander) (figure 3). In the locations where EVP are proposed, home herbal gardens are established for immediate access to the ingredients needed. Herbs needed and not available in the garden are purchased from herbalists, or village suppliers. Problems like contamination and adulteration or misidentification of the herbal ingredients are not recognised as a problem.

Figure 3. Herbal mixture to treat a cow’s mastitis with.

TDU and NDDB has already implemented EVP in 14 Indian states (figure 4). The NDDB is a statutory body set up by an Act of the Parliament of India. It is under the ownership of the Ministry of Fisheries, Animal Husbandry and Dairying of the Government of India.

Figure 4.The locations were EVP intervention is being applied under the guidance of TDU.

Much progress has been made to widen the EVP by showcasing its benefits, but several challenges/ barriers still need to be overcome [personal communication, Dr MNB Nair]. Some of these challenges are:

- Lack of validation and standardization of EVP using western science parameters
- Preference of the farmers and veterinarians for conventional medicine practices
- Inadequate disease diagnosis fascilities
- Low acceptance of EVP from veterinary professionals and minimal integration with conventional veterinary medicine
- Limitation in knowledge sharing and dissemination to reach farmers speaking the different languages spoken in the country.

Next steps

We will interview several stakeholders during the field trip, including farmers of small-sized and medium-sized dairy farms, nature conservation, veterinarians and academia (TDU) and the NDDB. The detailed field trip plan and questionnaire are prepared in a separate document. The field visit will collect as much information as possible following the CANVAS structure (Appendix 1). With the collected

information we will reflect on local understanding of nature and nature positive food production system, as well as the effectiveness of key performance indicators that have been identified within the project for the local stakeholders in this case study.

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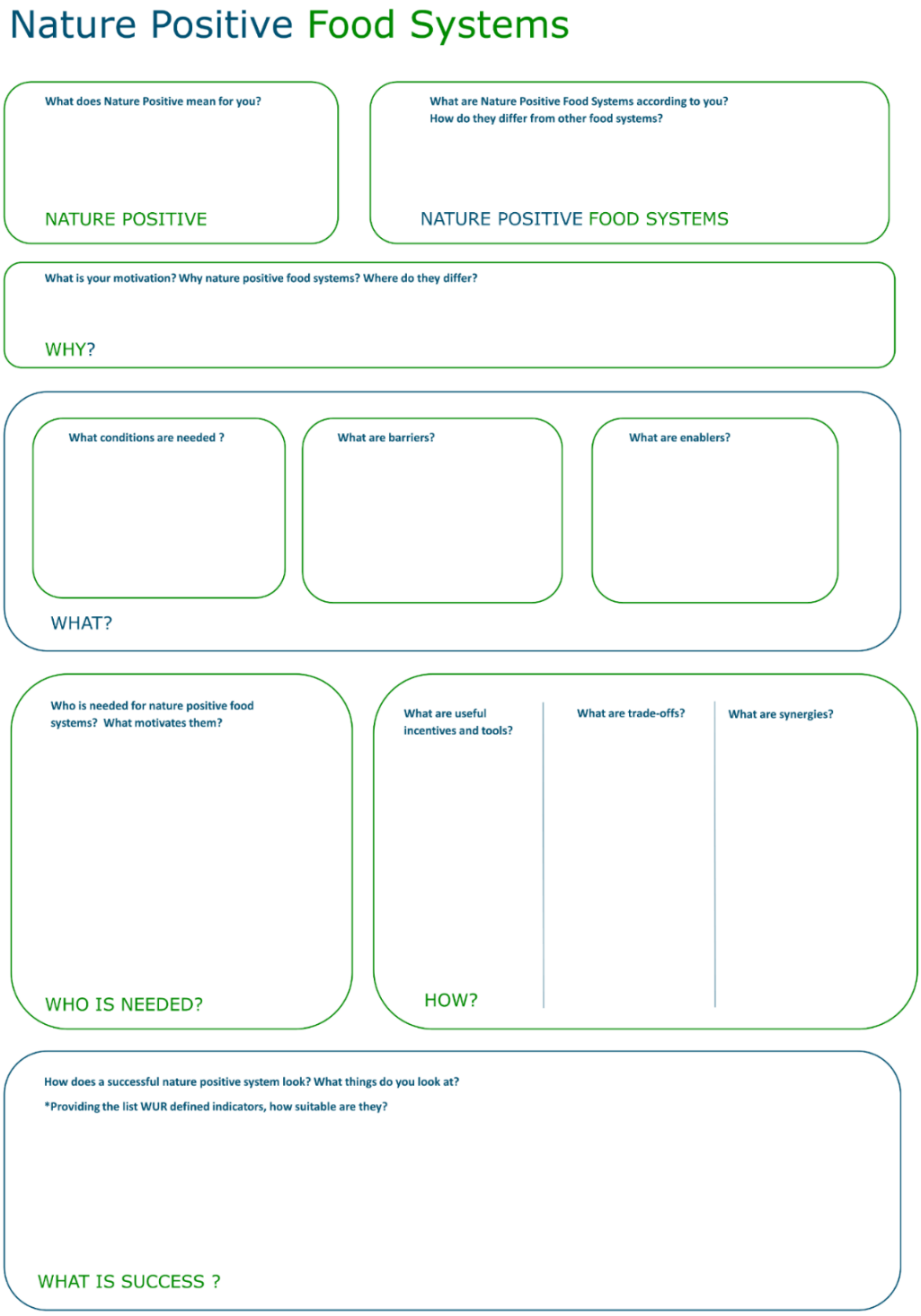

Appendix 1. CANVAS Nature positive food systems.