



Historical and cultural perspectives of pigs in ancient India and prospects of natural pig farming in contemporary India

R THOMAS¹, V K GUPTA¹, V K VIDYARTHI², R SOMVANSHI³, N M ATTUPURAM¹, S KUMAR¹
and R K SINGH⁴

ICAR- National Research Centre On Pig, Rani, Guwahati-781 131 Assam, India

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ABSTRACT

The mythology and ancient history of India reveal that the pig held great cultural and civilizational significance. The intriguing symbolism that a boar represented in our history can be discovered through a cultural revisit through the sculptures and inscriptions. The pig was also portrayed as a symbol of prosperity in ancient Indian agriculture. The domestication of pigs, *Sus scrofa domesticus*, has deeply impacted human societies across the globe, contributing to food security, agricultural practices, and cultural diversity. The current pig population in India is 9.06 million in comparison to the world population of about 778 million. Out of total pig population, 79.03 percent are indigenous and non-descript in India which make them well suited for natural farming. Current world pork production stand at 112.6 million tons, which has been estimated to grow at the pace of 2.3 percent year to year and expected to rise to 129 million tons by 2031. The world market for organic pork is a niche has been rapidly expanding segment within the global meat industry. At present pork is one of the most traded products in the world that held 136th position in 2022. India exported \$3.75M and imported \$2.97M pork in the year 2022, making it the 46th among the exporter and 112th among importer of pork in the world. There is no doubt that natural and sustainable pig farming, combined with value addition and carbon neutrality, will greatly increase the prospects for Indian pig sector.

Keywords: Cultural perspective, Export and import, Historical perspective, Natural, Organic pig farming, Value addition

A glance through India's ancient history and mythology show that the pig had a revered place in our ancient culture and civilization. In Hindu mythology, pig was revered as an incarnation of the Lord Vishnu and recognized by the name "Varaha" avatar. It is believed as the third incarnation of Lord Vishnu. The story of lifting the earth personified as the goddess Bhudevi out of the cosmic ocean was the most popular association of Varaha. (Verma 2012). Mythological literature describes Narayana/Prajapati who was roaming as the wind and acquiring the form of "cosmogonic" boar as Varaha (Emusha) to retrieve the earth (Bhudevi) from the cosmic deluge in the primordial waters by lifting it on his tusks and restoring Bhudevi to her place in the universe. Central Indian temples and archaeological sites of the Gupta era showed a large number of Varaha sculptures and inscriptions, signifying the revered status of boar (Shastri and Tagare 1999). These are the evidents from the anthropomorphic sculptures in Udayagiri Caves near Vidisha, Madhya Pradesh and the zoomorphic version in Eran. Other early sculptures can be found in

the cave temples in Badami in Karnataka (6th century), Mahabalipuram in Tamil Nadu (7th century), and Ellora Caves (7th century) in Western India (Lobban 1994). It is worth to be noted that by the 7th century, images of Varaha were found in all regions of India signifying the pan-India status of pigs. By the 10th century, temples dedicated to Varaha were established in Khajuraho, Udaipur, Jhansi etc. In abroad too, a cave painting of a boar was found recently on the Sulawesi Island of Indonesia and is believed to be 45,000 years old, making it one of the oldest cave paintings ever found (Harris 1974). It may be connected to the fact that these areas were once ruled by Hindu kingdoms, and the people practiced Hinduism for thousands of years in these regions. The transboundary influence of this mythological character can be seen in the pictures which depict Ramakien (The Thai Ramayana), wherein it indicates Witsanu (Vishnu) transforming into a boar to kill the demon Hiranta (Hiranyaksha).

Historical perspective: The sculptures and inscriptions reveal the interesting symbolism that a boar represented in our history. The boar was hailed as a "symbol of potency" during the first millennium. The colossal Varaha at Eran is a complete theriomorphic icon of Varaha established by the Huna king Toramana (510 CE) (Becker 2010). The Chalukya dynasty (543-753) adopted boar in their crest, minted coins with them and the boar remained their

Present Address: ¹ICAR-National Research Centre (NRC) on Pig, ²Agricultural and Processed Food Products Export Development Authority (APEDA), New Delhi. ³ICAR- Indian Veterinary Research Institute, Izatnagar, Bareilly (UP)-243122, India. ⁴Angelic Enterprises, New Delhi. ✉Corresponding author email: thomasrlpt@gmail.com

dynastic emblem. Similarly, The Gurjara-Pratihara king Mihira Bhoja (836-885 CE) assumed the title of Adi-Varaha and also minted coins depicting the porcine inscriptions (Fabre-Vassas 1997). Boar was also adopted as a part of royal insignia by the Chola (4th century BCE–1279 CE) and Vijayanagara Empires (1336–1646 CE) of South India. In Karnataka, a zoomorphic figure of Varaha may be seen in a sculpture on a pillar at Aihole. This image is thought to be the Vijayanagara emblem because it is accompanied by symbols of a disc, a conch, and a cross marked Sun. The emblem symbolized strength and protection (Sterndale 1884). The Varahadhvaja was the other great emblem that graced the flags of the Chalukyas and the Vijayanagara Empire. The Gupta emperor Chandragupta II commissioned a large sculpture of a boar trampling a serpent or Naga at Udayagiri, Madhya Pradesh, where an inscription nearby suggests that the scene was meant to commemorate the emperor's victory over various chieftains of Naga polities in central India (Roy 2002). The boar probably represented Chandragupta II. Porcine images remained as a popular theme in the artwork of the Gupta, Chalukya, Chola and Vijayanagar kings from the 3rd century to the 10th century. The Vijayanagara empire used the boar as its royal emblem and the Varaha was a standard unit of gold coins that was actually issued by this empire.

Religious perspective: Vishnu was depicted with a wild boar on one side and a lion head on the other in his early "Chaturmukha" form, which was common in Kashmir 1,500 years ago. In addition to his own monkey head, Hanuman's Panchmukhi form also features the heads of a horse, a lion, and an eagle. Varahi, also known as the female boar (sow), is a potent goddess associated with strength and fertility in Tantra. In Tantrik Buddhism, the wild boar is associated with the goddess of dawn, Marichi (Krishna 2010). It is said that she rides the chariot pulled by seven wild boars, reminding us of the seven wild horses that pull Surya's chariot. Vimalnath was the Tirthankar connected to the wild boar in Jain customs. Panjurli Daiva (The Boar God), is still worshipped in Karnataka. According to Tulu mythology, the boar was sent to earth by Lord Shiva and was tasked with protecting the people of earth and assured him that he will be revered by the people as a protector god. This specific boar evolved into Panjurli, a Bhoota (divine spirit). Panjurli was one of the most powerful spirits worshipped in the Bhuta region (Rao 1914).

Ancient literature: Ancient texts like the Rigveda, one of the oldest sacred texts in Hinduism, mentions the rearing of pigs as a form of livestock farming. It describes pigs as "givers of happiness" and highlights their role in converting waste into valuable resources. The verse 10.86.13 of Rigveda refers to the concept of "dogs and pigs" being mentioned in the context of understanding divine knowledge and the mysteries of existence (Krishna 2010). This verse metaphorically highlights the limitations of human perception and that need to seek deeper wisdom. Similarly, the verse 10.28.10 of Rigveda mentions "dappled-footed boars," which can be interpreted

as a reference to wild boars (Shastri and Tagare 1999). This verse is a part of hymn that praises various animals, including horses, cows, goats, and boars, emphasizing their divine significance and roles in the natural world. A review of old literature mentions several examples of pork being consumed. The Manasollasa, a 12th century text composed under Someshwara III, ruler of the Western Chalukya kingdom, had detailed directions on how to prepare pig carcasses and make them into sunthakas (roasted pork steaks) (Jerdon 1874).

The boar and the concept of wealth: The references connecting the boar to wealth are found in ancient Indian literature. In the Taittiriya Samhita (6.2.4) it was told that the boar "plunders the wealth of the Asuras" (Becker 2010). The Panchamukha Hanuman Kavacham read as "*Om namō bhagavatē pañcavadanāya uttaramukhāya ādivarāhāya sakalasampatkarāya svāhā*". This tells us that the Northern face, which is Adi Varaha (the "original boar"), is called as the "giver of all wealth". Lord Kubera, who is a pot-bellied dwarf, is the treasurer of the Devas (demigods), and sits upon a wild boar as his mount (vahana). He is the protector of the Northern direction and is holding a money pot filled with coins. Echoes of the Vedic past can be seen in the simple image of the piggy bank: the clay represents the goddess of the Earth, the coins represent the goddess of fortune, and the earthenware in the shape of a boar represents Yajna Varaha, the presiding deity of sacrifice and the source of all wealth.

Socio-cultural perspective: The pig was also portrayed as a symbol of prosperity in agriculture. Boar was even considered Bhupati- "Lord of the Earth" and Prithvi Vallaba - "beloved of the earth". Related mentions are available from the Varaha avatar stories after Bhudevi (Earth) was rescued. It may also be a poetic description of the boar's inherent ability to dig the earth for roots with its snout to loosen the soil, a lovemaking with the earth that aids seeds to sprout and keep her fertile (Sen 1977). Pig rearing has been prevailing among various tribal communities in India for generation after generations. Tribes such as the Gond, Kuki, and Naga have traditionally practiced pig farming as a means of sustenance and as an integral part of their cultural and religious practices (Krishna 2010). Pig husbandry was not at all a taboo till the arrival of new religions through invaders who considered pigs as "unclean" and subsequently, pig farming got restricted to the population least influenced by the invaded rulers. This is evident from the present-day popularity of pork being mostly focused on areas especially, tribal belts and northeastern states where these kingdoms exerted minimum influence. In the due course of time pig husbandry got restricted to the scavenging system of husbandry, especially in urban and peri-urban areas, unlike the backyard practices which continue to be the popular swine husbandry system in the North Eastern parts of India.

History of evolution of pig: Pig domestication holds immense importance in the realms of human history and agriculture. The domestication of pigs, *Sus scrofa*

domesticus, has deeply impacted human societies across the globe, contributing to food security, agricultural practices, and cultural diversity. The evolutionary journey and geographical dissemination of pig domestication, with a specific focus on the Asian and European lineages has been discussed. *Sus scrofa domesticus* belongs to subfamily *Suidae*, a widespread pig species group of Cetartiodactyla that originated in the Oligocene almost 20 million years ago (Frantz *et al.* 2020). The domestic pig, *Sus scrofa domesticus*, traces its lineage back to the wild boar, *Sus scrofa*, which inhabited forests and grasslands across Europe and Asia. Genetic studies have indicated that pig domestication occurred independently in different regions, with distinct Asian and European lineages. *Sus scrofa* originated on the island of south-east Asia during the early Pliocene climatic fluctuations about 3–4 million years ago (Sharma *et al.* 2023). The northern Sumatra wild boar population, which split from the Eurasian wild boars approximately 1.6–2.4 million years ago, is the earliest diverging lineage of pigs discovered till date. *Sus scrofa* has colonized nearly the whole Eurasian continent over the last million years. Asia and Anatolia (the Near East) are considered as the two places where early domestication of pigs was started. Pig domestication in Anatolia has been well documented, indicating domestication ~ 10000 years ago based on archaeological evidence while pig domestication in Asia happened at least 8000 years ago based on zooarchaeological analyses.

Beginning of domestication of pigs: Archaeological evidence suggests that early agricultural communities started selective breeding of wild boars for desirable traits such as docility and higher food conversion efficiency. This led to the emergence of diverse pig breeds adapted to regional environments and human needs (Frantz *et al.* 2020). Both Asian and European societies selectively bred wild boars to suit their requirements, resulting in various

regional breeds with distinctive traits and characteristics. In Asia, the regions where pig domestication took place include China, India, Southeast Asia, and some parts of the Korean Peninsula.

Current status of pig farming in India: According to the 20th livestock census of India, the country's pig population is 9.06 m in comparison to the world population of about 778 m. The position of India in pig production within Asia is also below the top five viz. China, Vietnam, Philippines, Japan, and Indonesia. India's contribution to the total pig production in Asia is only about 1%, while China alone contributes more than 80% (Thomas *et al.* 2021). With the exception of the 1960s, the pig population in India showed a positive trend from the beginning to the year 2000. However, during the last 15 years, the growth rate in pig population in India has been found to be negative. The reasons might be multi-faceted, but the major ones are surely the socio-cultural inhibition, emergence of transboundary diseases, inadequate financial availabilities, etc. Therefore, the challenge is to reverse the declining growth trend through the application of latest science, technology and innovation, and institution of development measures. Pigs are found in all of the country's ecoregions and are a major source of income for rural communities, particularly the tribal masses. For festivals and ceremonial purposes, members of some ethnic groups in the nation prefer to keep pigs, particularly black ones (Bujarbaruah *et al.* 2007). The highest pig population is observed in eastern and north eastern (NE) states, followed by the northern, southern, central and western India (Table 1). The highest population is in Assam (2.10 million), succeeded by Jharkhand (1.28 million), Meghalaya (0.71 million) and West Bengal (0.54 million). The northeastern regions contribute about 40% of the pig population of the country. Indigenous non-descript pigs (79.03%) mainly cornerstone the pork production in India followed by

Table 1. Details of pig population in India

Category	Population in 2012 (in million)	Population in 2019 (in million)	% Change
<i>Pig population – Consolidated</i>			
Exotic/ Crossbred	2.46	1.90	-22.76
Indigenous/ Non-descript	7.84	7.16	-8.66
Total pigs	10.29	9.06	-12.03
<i>Pig population in major pig producing states</i>			
Assam	1.64	2.10	28.30
Jharkhand	0.96	1.28	32.69
Meghalaya	0.54	0.71	29.99
West Bengal	0.65	0.54	-16.63
Chhattisgarh	0.44	0.53	20.01
Uttar Pradesh	1.33	0.41	-69.37
Nagaland	0.50	0.34	-47.14
Bihar	0.30	0.32	6.25
Karnataka	0.30	0.32	6.25
Mizoram	0.25	0.29	19.26

Source: 20th Livestock Census Data, Deptt. of Animal Husbandry, Dairying and Fisheries, Govt. of India

crossbreds and exotic germplasm (20.97%) (Fig.1).

Pig production and population in leading countries: Majority of pig population of the world is in China (~48%) followed by United States of America (~6.5%), Brazil (~4%), Germany (~2.8%) and Vietnam (~2.7%). In the year 2023 the worldwide population of pigs were 778 million heads, that had shown a down trend from its previous year (Devendra and Thomas 2002). As indicated above, among the top pig producing countries, China leads the world with over 434 million pigs as the data available as of April 2024. Brazil also stands out with a significant pig population of 40 to 50 million, supporting its substantial pork export market. In the European Union, countries like Germany, Spain, and France collectively contribute to a large pig population exceeding 150 million, driven by diverse production systems and strong export capabilities. Russia and Vietnam are other notable countries with pig populations growing due to increasing domestic and export demands. These leading countries' production and population levels highlight their critical roles in shaping global pork supply and influencing international trade dynamics. The European Union and USA occupy the second and third position respectively with the head counts of 133 million and 75 million pigs, respectively. Asia holds the largest population of 59.8% of the total pig population of world. The pig distributions of the world are as follows: Asia -59.8; Europe-19.5; America-16.9; Africa-3.3 and Oceania-0.5% (Indian Livestock Census 2019).

World market size and compound annual growth rate: The world market for pigs and pork represents a critical segment of the global food industry, characterized by its vast scale, intricate dynamics, and significant economic impact.

The market encompasses a broad range of activities, from large-scale commercial pig farming to intricate global trade networks and local consumption trends (Table 2). In recent years, the global market for pigs and pork has experienced notable shifts influenced by factors such as changing dietary habits, economic fluctuations, and advancements in production technology (Zhang *et al.* 2022). Major pork-producing countries like China, the United States, and Brazil play pivotal roles in shaping market dynamics, while evolving consumer preferences and health considerations impact both supply and demand. The value of the global pork market runs into hundreds of billions of dollars annually, driven by both domestic consumption and international trade. As countries adapt to emerging challenges and opportunities such as disease management, sustainability concerns and shifting trade policies, the pork market continues to evolve, reflecting broader trends in global agriculture and food security (Gupta *et al.* 2024). Understanding the world market size for pigs and pork provides valuable insights into the interconnected nature of food production and consumption, highlighting the

Table 2. World market size for pork and compound annual growth rate (CAGR)

Area	Revenue (in million USD)	CAGR %
Global	3151.2	2.3
North America	1260.48	0.5
Europe	945.36	0.8
Asia Pacific	724.78	4.3
South America	157.56	1.7
Middle East & Africa	63.02	2

Note: Base Year: 2023; Forecasting Period: 2024 – 2031

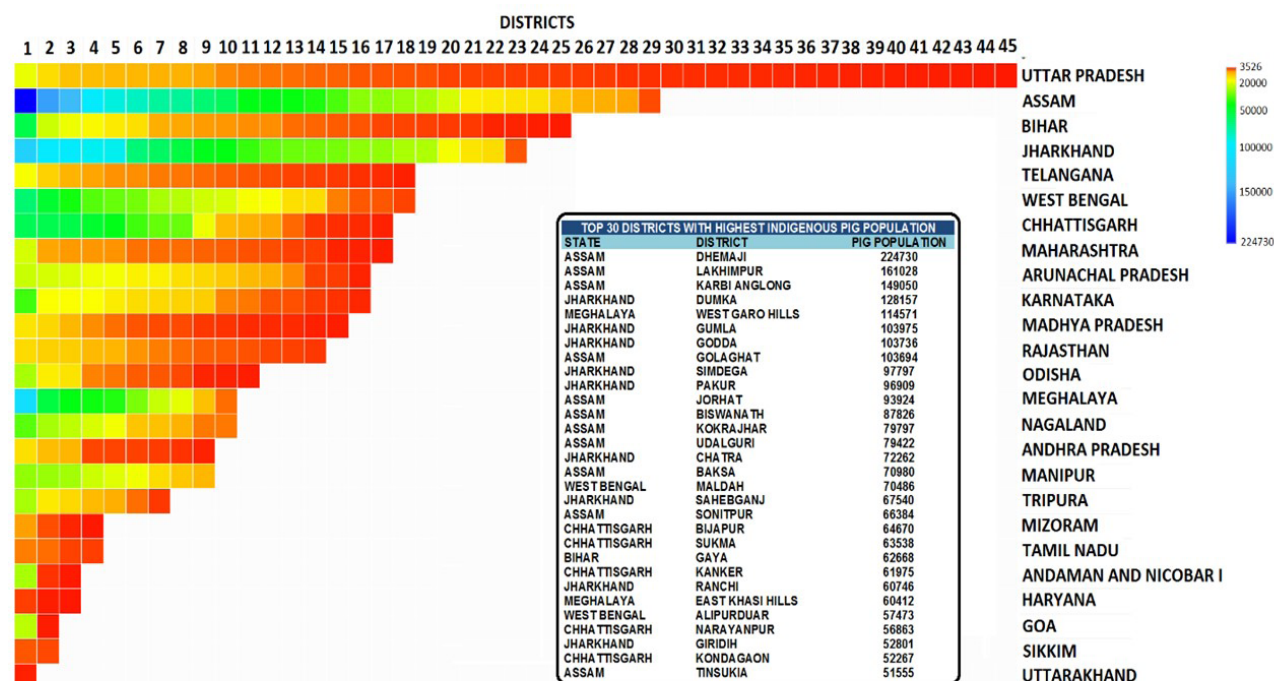


Fig. 1. Heat map indicating district wise distribution of indigenous pig population in India

importance of this sector in addressing global dietary needs and economic stability.

Natural vs Organic vs Conventional pig farming: *Natural Farming:* Natural farming, also known as zero-budget natural farming, is a farming approach that emphasizes minimal external inputs and relies on locally available resources. It aims to imitate natural processes and cycles to create a sustainable and self-sufficient agricultural system (Gupta and Bujarbaruah 2005). In pig husbandry, natural farming involves providing pigs with a natural, chemical-free environment, and utilizing locally available resources for feed and waste management (Table 3). In other words it can be defined as the chemical free husbandry based on indigenous breeds which are climatic resilient and locally available resources are used for on-farm biomass recycling.

Organic Farming: Organic farming is a method that prohibits the use of synthetic chemicals, genetically modified organisms (GMOs), and antibiotics. Instead, it relies on organic inputs, such as organic feed, natural fertilizers, and environment friendly pest control methods (Das *et al.* 2013). Organic pig farming emphasizes on animal welfare, sustainable practices, and the promotion of biodiversity. Organic pig husbandry allows use of indigenous or exotic breeds but the feed ingredients need to be organically certified. The source of inputs need not be locally raised as required in natural farming, but it needs to grow purely on organic conditions.

Conventional Farming: Conventional farming is the most widely practiced form of farming globally and typically involves the use of synthetic inputs such as chemical fertilizers, pesticides, and antibiotics. In conventional pig farming, pigs may be raised in intensive systems with limited access to outdoor spaces and may receive growth promoters and antibiotics to maximize production (Kumaresan *et al.* 2008). Intensive systems often involve the use of confinement housing, high stocking densities, and the feeding of commercial feeds. Such systems prioritize high production and profitability but often neglect the welfare of the animals and long-term

environmental sustainability.

Indigenous breeds suited for natural pig farming: The members of some ethnic groups prefer to keep more pigs, particularly black ones. Of the total number of pigs, 79.03% are native and non-descript (Table 4). Most of these population are yet to be characterized with proper scientific intervention (Behl *et al.* 2020). These pigs are of smaller size and systematic efforts yet to be made for their conservation and selection to improve economic traits, such as litter size, birth weight, weaning weight, average daily gain, feed conversion efficiency and carcass traits (Gupta *et al.* 2023). These animals are well adapted to hot and humid environment and presumably have better disease tolerance. The indigenous pigs of India have been identified as a distinct group as a result of gradual domestication of wild pigs to their surroundings (Paris 2002). Depending on the topography and climate, these pigs' traits and colors vary from one part of the nation to another

Feeding practices for natural vs organic vs conventional pig farming: Unlike organic pig production, where an extensive list of feeding requirements has been established both in India and other countries, we don't know the requirements for natural pig farming practices in India. The nutrient requirements for natural pork production are very similar to those for organic production. In the current situation, producers interest in natural production of pork has to be identified, a group that markets natural pork and follow its standards or requirements. However, there are extensive standards for organic production of pork. Organic agriculture has been defined by a number of national and international organizations. These definitions address ethical, social, and environmental objectives and ideals. Only three types of ingredients are permitted in feed made for organic pork production: non-synthetic substances like probiotics, enzymes, and other naturally occurring substances; agricultural products that were produced and handled organically; and synthetic substances that are listed on the national list of synthetic substances permitted for use in organic livestock production (Barman *et al.* 2020).

Table 3. Comparison of different pig farming practices

Farming practice	Advantages	Disadvantages
Natural Pig Farming	Reduced cost of inputs, as it relies on locally available resources.	May have slightly lower production yields compared to conventional methods.
	Environmentally sustainable and promotes soil health.	Requires greater knowledge and understanding of ecological processes for successful implementation
	Lower risk of chemical residues in meat products.	
	Improved animal welfare due to natural living conditions	
Organic Pig Farming	Market premium for organic pork and pork products.	Higher costs of production due to expensive organic inputs.
	Promotes biodiversity and environmental conservation.	Stringent certification and compliance requirements.
	Enhances long-term sustainability.	Slightly lower production yields compared to conventional methods.
	Limited use of antibiotics reduces the risk of antibiotic-resistant bacteria	
Conventional Pig Farming	High production yields and faster growth rates.	Environmental pollution from synthetic inputs.
	Lower initial investment and lower production costs.	Antibiotic resistance concerns.
	Well-established and widely practiced method	Potential negative impacts on animal welfare in intensive systems.

Table 4. Registered indigenous pig breeds of India

Name of breed	Distribution (State)	Accession Number
Ghungroo	West Bengal	INDIA_PIG_2100_GHOONGROO_09001
Niang Megha	Meghalaya	INDIA_PIG_1300_NIANGMEGHA_09002
Agonda Goan	Goa	INDIA_PIG_3500_AGONDAGOAN_09003
Tanyi-Vo	Nagaland	INDIA_PIG_1400_TENYIVO_09004
Nicobari	A&N Island	INDIA_PIG_3300_NICOBARI_09005
Doom	Assam	INDIA_PIG_0200_DOOM_09006
Zovawk	Mizoram	INDIA_PIG_2700_ZOVAWK_09007
Gurrah	Uttar Pradesh	INDIA_PIG_2000_GHURRAH_09008
Mali	Tripura	INDIA_PIG_1900_MALI_09009
Purnea	Bihar, Jharkhand	INDIA_PIG_0325_PURNEA_09010
Banda	Jharkhand	INDIA_PIG_2500_BANDA_09011
Manipuri Black	Manipur	INDIA_PIG_1200_MANIPURIBLACK_09012
WakChambil	Meghalaya	INDIA_PIG_1300_WAKCHAMBIL_09013
Andamani	Andaman & Nicobar	INDIA_PIG_3300_ANDAMANI_09014

Note: Some other prominent variants of pigs like Andaman Wild, Andaman Local, Ankamali, Burudi, Dome, Golla, Lepchamoun, and Pondi/Jhinga are yet to be characterized for registration.

Even though animals sold to organic markets are prohibited from using antibiotics or other medications, this does not mean that animal welfare should be disregarded if an animal becomes ill or needs medication (Gupta *et al.* 2007). Indeed, a producer of organic livestock is required to provide vaccinations and other veterinary biologicals as necessary to ensure the health of the animals under their care. The producer may use drugs that are permitted for use in organic production systems to prevent illness when preventative measures and veterinary biologicals are insufficient. When techniques that meet organic production standards are not successful, all necessary drugs and therapies must be used to bring an animal back to health. Livestock treated with banned substances must be identified clearly and cannot be sold, labeled, or presented as organic. Corn-soybean meal-grain-oil cake-based diets are typically used in Indian conventional pig farming because of the availability, high nutritional value, and competitive cost. Similar formulations are being used for organic production with organically-produced corn, soybean meal, grains or oil cakes (Naidu and Kondaiah 2004). However, the high cost and limited availability of organically-produced corn, soybean meal, grains and oil cakes may preclude their use in some organic production systems. In order to lower costs and diversify crop rotations on organic farms, there is a lot of permissible substitute ingredients. Given the high price of organic grains as energy and protein sources, producers may consider maximizing pasture contributions during the months when grazing is feasible and its nutritional contributions should be taken into account.

World pork consumption pattern: Pork consumption patterns around the world reveal a fascinating tapestry of culinary traditions, economic conditions, and cultural influences. As one of the most widely consumed meats globally, pork holds a prominent place in the diets of diverse populations, each with unique ways of preparing and enjoying it. In some regions, pork is a staple protein,

deeply embedded in daily meals and traditional recipes. In others, religious or cultural taboos restrict its consumption, influencing dietary choices and food systems (Gurunathan *et al.* 2022). This global panorama of pork consumption reflects not only varying taste preferences but also broader trends in agriculture, trade, and health. Understanding these patterns offers valuable insights into global food dynamics, highlighting how local practices and international influences shape dietary habits and food industries around the world. The taste of pork is suitable to the palates of the natives of the various nations, which drives the global intake of 36% of meat consumption. This is a very significant portion stands for 112.6 million tonnes (MT) in recent year, which is estimated to grow at the pace of 2.3% every year and expected to rise to 129 million tonnes (MT) by 2031 (Gupta *et al.* 2024). We have considered the nations those may seemed desired destination due to their ethnicity, versatility in cooking, cultural significance and logistical proximity and preferences for the Indian exports. Global average, per capita consumption of pork is 38 kg/year. Per capita consumption per year of the few of the nations are explained in the table hereunder to understand their dietary preferences (Table 5).

Table 5. Per capita consumption of pork in top ten countries

Country	Quantity (in MT)	2022	2021	2020	% Change
China	57.268	40.18	36.42	30.06	31.18
South Korea	2.142	41.37	38.3	38.01	8.83
Italy	2.064	34.62	35.58	33.15	4.43
Vietnam	3.219	32.29	31.51	26.86	20.22
Russia	4.271	29.34	28.28	28.12	4.34
Japan	2.823	22.58	21.83	21.54	4.83
Mexico	2.799	21.76	20.13	19.72	10.34
Brazil	3.479	16.54	15.38	14.45	14.47
Philippines	1.746	15.32	13.85	14.26	7.43
Thailand	0.934	13.02	12.98	12.8	1.72

Note: Consumption per capita in Kg

World market for organic and natural pork: The world market for organic and natural pork is a niche yet rapidly expanding segment within the global meat industry. Driven by increasing consumer awareness and demand for healthier, more sustainable food options, this market is characterized by a focus on high-quality production practices. Organic pork, produced without synthetic pesticides, antibiotics, or growth hormones, and natural pork, which is minimally processed and free from artificial additives, are gaining interest among health-conscious consumers and those concerned about animal welfare (Thomas *et al.* 2006). Although smaller in scale compared to conventional pork, the market for organic and natural pork is valued in the billions of dollars annually and continues to grow as consumers seek transparency and ethical practices in their food sources. Regional trends reveal varying levels of market development (Edwards 1989). In the United States and Europe, the organic and natural pork sectors are relatively well-established, with significant consumer bases and a growing array of products available in both specialty and mainstream stores. In the US, major producers and retailers are expanding their offerings to meet rising demand, while Europe, particularly countries like Germany, France, and UK, benefits from strong regulatory frameworks and consumer awareness (Willer and Lernoud 2017). Conversely, in regions like Asia, where pork consumption is high but organic and natural products are less prevalent, the market is emerging but faces challenges related to production infrastructure and consumer education.

Even with its positive growth trends, the organic and natural pork market faces several challenges, including higher production costs, limited supply of organic feed, and complex certification processes. Prices for organic and natural pork products are typically higher than conventional options, reflecting the increased costs associated with these production methods. However, as consumer demand for sustainable and ethically produced food continues to rise, there are significant opportunities for expansion. Innovations in production techniques, improved supply chains, and increased availability of organic feed could help address these challenges and support the continued growth of the organic and natural pork market globally.

Organic and natural pork market trends: The pork business is changing as a result of this trend, forcing producers to adopt sustainable agricultural practices and adjust to shifting customer demands (Blumetto Velazco *et al.* 2013). The market demand for organic meat products is expected to grow due to consumers' rising preference for organic products. This can be attributed to the growing health concerns among consumers and increasing awareness about the health benefits associated with the consumption of organic products (Wilson and Johnson 1981). Recent past has witnessed strong regulatory support from the Government towards propagating organic and natural animal production practices and has also influenced the market for natural and organic pork. Regulatory bodies

have to ensure that organic/natural pork products meet specific standards and provide certification only to those farmers who comply with organic or and natural farming practices. Increasing availability of organic or and natural pork in retail stores, supermarkets and e-commerce platforms has made it accessible to consumers. By reaching a larger consumer base, this retail channel expansion has aided in the market's growth.

However, the higher price factor is likely to hinder the growth of the market. The organic/ natural meat production process is expensive, takes more time, and is labor-intensive (Das and Bujarbaruah 2005). In order to obtain an edge, producers also charge higher prices for "on-demand" goods. However, the premium price frequently makes organic and natural pork products less affordable, which is found to be impeding the market's expansion. Limited supply of organic and natural pork in the market, which usually attributes to adherence to strict organic farming regulations, which may limit the supply compared to conventional pork. The limited supply can pose challenges in meeting the increasing demand for organic and natural pork in the market. Another aspect is lack of awareness among the consumers. Despite the growing popularity of organic and naturally produced food, there is still a lack of awareness among the consumers about the benefits of organically and naturally produced pork.

Pork exports and imports by leading countries: The global trade in pork is dominated by key exporters like the United States, European Union, Brazil, and Canada, each contributing significantly to the global supply with exports often exceeding several million metric tons annually. The United States, with its expansive production capacity and established trade relationships, is leading in exports to major markets such as China, Japan, and Mexico (Mohan *et al.* 2021). The EU also plays a critical role, with substantial exports driven by countries like Spain and Germany. Brazil's competitive pricing and production scale make it a major supplier to China and other key markets. On the import side, China is the largest buyer of pork, with imports driven by high domestic demand and periodic supply shortages, primarily sourcing from the US, EU, and Brazil. Countries like Japan, South Korea, and Mexico also play significant roles in global pork imports, relying on exports from these leading producers to meet their domestic needs. The intricate balance of global pork trade reflects a complex interplay of production capacities, trade policies, and shifting market demands. Pork trade occupies 0.14% of total world trade. Pork is one of the most traded products of the world that held 136th position in year 2022 though between 2021 and 2022 the quantity of exports decreased from US\$ 36.8 billion to 34.0 billion, a net decrease by 7.61%. The pork trade ranks 316th in the product complexity index (PCI) (Gupta *et al.* 2024).

Pork export-import scenario in India: India's pork export-import scenario is characterized by modest activity, with both exports and imports being relatively limited compared to global standards. Pork exports from India are minimal,

typically focused on neighboring South Asian markets and the Middle East, reflecting the country's smaller presence in the global pork trade (Thomas and Sarma 2017, Thomas *et al.* 2021). Import levels are also low, generally below 20,000 metric tons annually, with imports sourced from countries such as the United States, Canada, and the European Union to meet specific domestic demands not covered by local production. India's pork sector faces challenges including limited production capacity, infrastructure constraints, and trade barriers, which contribute to its modest role in international pork markets. Despite these limitations, there is potential for growth as urbanization and evolving consumer preferences drive increased demand for pork, provided that improvements in production efficiency and market access are achieved. India exported \$3.75M pork in the year 2022, making it the 46th among the exporter of pork in the world. In the same year, pork was the 984th most exported product in India (Gupta *et al.* 2024). The main destination of Pork exports from India are: Bhutan (\$3.75M), Maldives (\$2.89k), and Tanzania. On the other hand, India imported \$2.97M in pork in the year 2022, becoming the 112th largest importer of pork in the world. During the same year, pork was the 1019th most imported product in India. India imports pork primarily from: Belgium (\$1.94M), Spain (\$525k), Canada (\$176k), Poland (\$161k), and Brazil (\$97.4k).

The trend of pork consumption is quite encouraging and so the market share in the world trade. India being logistically and very strategically located to the main consumer markets like- China, Japan, Vietnam, Philippines, Italy, Russia etc. can do tremendous contribution and place herself very well in the list of world exporters list. Natural and sustainable pig farming with additional value addition to carbon neutrality can definitely going to create very high prospect for exports of pork from India. By resolving the challenges of quality, packaging and logistics of Indian pork, certainly India can lead the world to feed protein reach diet to the growing population.

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